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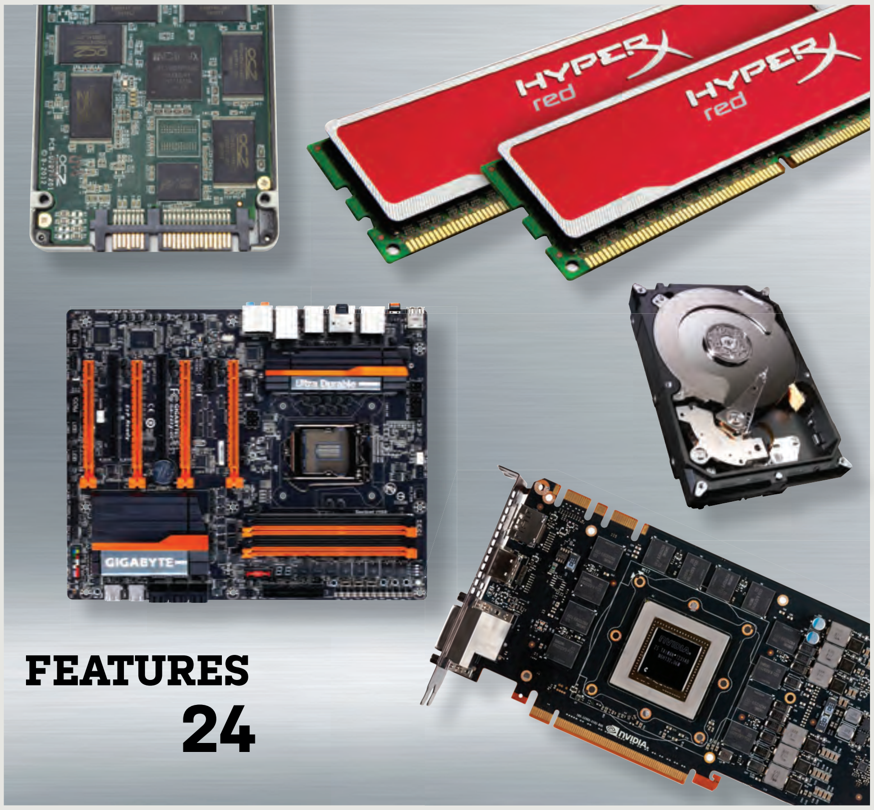


On the Cover
Photography by
Mark Madeo

inside
AUGUST 2013



Pebble Watch











MAXIMUM PC

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Gordon Mah Ung

IS IT REALLY ANY DIFFERENT?

I RECENTLY BOUGHT A used computer from a friend. He had done a clean install of the OS before I started using it but something was still wrong.

The battery kept running down far faster than it should have, the Wi-Fi reception was atrocious, and man, the occasional lag was horrible, and installing the Chrome browser killed performance. I had unfortunately installed all of my applications and didn't want to nuke it, but that's ultimately what I did, but only after booting into safe mode, erasing the system's cache—not once, but twice—and doing a complete reinstall of the OS, reformatting all of the drives and also running down the battery to recalibrate it.

I speak not of a used x86 laptop computer but of a used (but still practically new) Android smartphone. For the most part, the phone is performing where it should be now, but only after I spent four days trying to diagnose the problem and another day wiping it out and reinstalling. I still can't install the Chrome browser on it without performance going to hell, but I've given up on that one.

My real-world anecdote is meant to counteract a common belief among the general population: Phones and tablets are better than PCs because they require zero maintenance and never break. I acknowledge that, for the most part, these mobile devices do generally work, but I also acknowledge that, for the most part, so does the average PC.

And for the naysayers who'll contend that it was just an isolated event, or that I should have tried iOS, I challenge you to go to any cell phone carrier's website and cruise the support forums. People aren't there talking about sunshine and rainbows. They're pissed off and confused because X isn't doing Y.

What's really a laugh is when people talk about how they're glad they're finally off the PC upgrade treadmill but then fawn over the latest eight-core phone with the 5-inch screen to replace the device they bought six months ago. What, the new GPU in the new SoC is 20 percent faster? Sign me up for another two-year contract!

Let's not even get into the aspects of the OS upgrade lag. That's the time between when a new OS comes out and when the phone you bought five months ago finally gets it, some 15 months later, if you're lucky to get it at all. Finally giving up, the consumer just goes out and buys a new phone or tablet with the latest OS, instead.

If the PC world worked like that, pitchforks and torches would line the road leading up to the castle overnight. If anything, maybe phones could learn a thing or two from the PC and provide timely security and OS updates to everyone, and actually work to improve drivers once in a while. Until then, while I still love my now-working phone, I still love my PC, too.



Gordon Mah Ung is Maximum PC's deputy editor, senior hardware expert, and all-around muckraker.

↘ submit your questions to: comments@maximumpc.com

THE NEWS

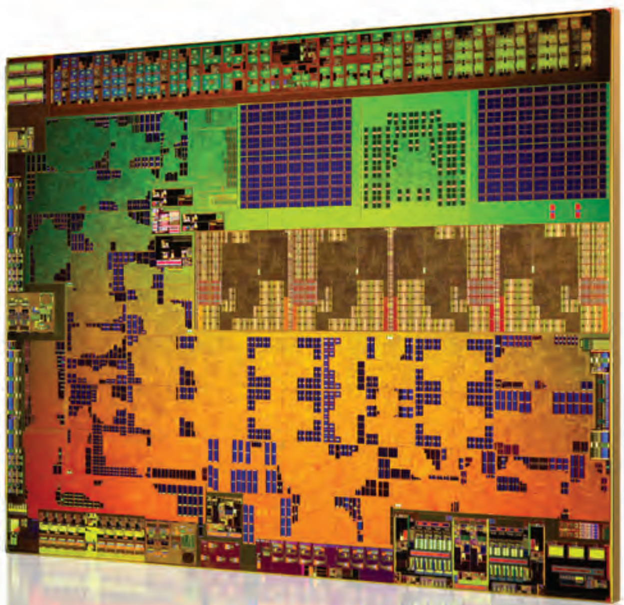
AMD's Richland: Can Intel Answer?

The green team looks to extend its lead in the APU sector with its third-generation chip

WITH ALL THIS back-and-forth lately between AMD and Nvidia, you might have forgotten about the green team's CPU department. There's plenty of room to compete in mobile devices, and in entry-level computing that doesn't need a separate video card. AMD is on track to release its third generation of APUs (Accelerated Processing Unit), a direct successor to the Trinity line that we know as the A10, A8, A6, and A4. The new generation is subdivided into three different cores, but it's the "Richland" core in the new A8 and A10 that interest us the most. The Trinity series is already the best performer in the APU sector, and Richland is basically the Intel Core i7 of this department for the foreseeable future.

A bold claim? Let's dissect.

There are two main improvements at play. One is the IGP (Integrated Graphics Processor). You've probably seen the videos on YouTube by now of people using the Trinity A10 to play games like League of Legends or Portal 2 at 1080p with all visual effects enabled. That's pretty good for a chip that listed for $130 at press time. If your CPU didn't have an IGP, the video card alone would cost you $75-$100. Intel doesn't have any CPUs near that price point that deliver that much visual horsepower. If it sounds like black magic to you, we actually got our grubby hands on the Richland A10 and can confirm its high degree of respectability. It outperformed Haswell's HD 4600 IGP at nearly every turn, without overclocking or other tricks, despite costing about $100 less.



Is it a Richland CPU, or a psychedelic Legend of Zelda map? You decide!

Intel will cramp AMD's style when its Core i3 Haswell parts come out some time later this year, but it's hard to say how much. AMD PR Manager Peter Amos tells us, "It is difficult to make specific claims about performance relative to an unreleased part from the competition. We expect that we will continue to have very compelling offerings in terms of power consumption, performance, and price when Haswell products become available."

And AMD loves diversifying its portfolio. The company would like to get Richland into laptops and high-end tablets too, and that requires good battery life. Lately, the key term here has been "idle time." While we use our mobile devices for watching movies, listening to music, and sometimes playing games, you may be surprised how much time it spends doing little to nothing. And writing a document, loading an occasional webpage, checking your email, Facebook, and Twitter—these activities barely register on a modern CPU. They need so little power that you can set the CPU to a very low voltage to preserve juice. Now, we don't have a mobile version of Richland on hand (yet), but AMD is claiming about 10 hours of idle time for the A8 version, in a full-fledged laptop being used by actual people.

While AMD seems constantly beleaguered, Apple operated under the same perception throughout the 1990s, until it blew the doors off with its iPod. We don't know if AMD will produce a similar level of game change at some point in the future, but the point is that you can never count out the bright minds of Silicon Valley. And everybody loves a scrappy underdog. **–Tom McNamara**



Dell Profits Plunge 79 Percent

Dell Inc., the manufacturer of laptops and pre-built desktops like the Inspiron and XPS, reported that its profits in Q1 2013 were down 79 percent to $130 million, compared to $635 million in Q1 2012. However, its revenue of $14.1 billion was down just 2 percent. In a press release, Dell's chief financial officer Brian Gladden said, "We have taken actions to improve our competitive position in key areas of the business, especially in end-user computing, and it has affected profitability."

Dell's end-user computer sales slid 9 percent to $8.9 billion. Dell's Enterprise division picked up some of the slack with revenue climbing 10 percent to $3.1 billion. Dell Services also saw some growth, increasing 2 percent to $2.1 billion. **–PL**

IDC Predicts PC Sales Slump

In late May, market research firm International Data Corporation downgraded its PC shipment forecast for the remainder of 2013, expecting worldwide PC shipments to fall by 7.8 percent. It said in its report that users will "increasingly consider alternatives such as delaying a PC purchase or using tablets and smartphones for more of their computing needs."

IDC says the updated forecast takes into consideration the significant drop in volume during the first quarter. We're still talking about hundreds of millions of PCs, mind you—321.9 million in 2013, to be exact. By 2017, that number will jump to 333.4 million, still shy of the 349.2 million shipped in 2012 but hardly indicative of a lethargic market. **–PL**



Realistic Videogame Hair Achieved?

While AMD's TressFX does an admirable job of creating realistic hair effects in games, it introduces a substantial performance hit, such that it's not practical unless you're using the fanciest hardware. News site ExtremeTech reported in late May that researchers at Princeton and USC had cracked the code with a less taxing method.

Rather than simulating the behavior of every single strand of hair (numbering in the thousands or more), they use a new process called Structure-Aware Hair Capture (SAHC). This creates a 3D model from a few photos of a person's hair. The model's hair is then sectioned into ribbons instead of strands, and the ribbons are further separated into "wisps," with some calculations done to figure out a realistic-looking physics simulation. The process still requires some manual visual adjustments, for now. **–TM**



Tom Halfhill
Fast Forward

INTEL RETHINKS ATOMIC POWER

ENGINEERING is all about making trade-offs, and a great example is Intel's new "Silvermont" Atom CPU core. Silvermont is Atom's first full redesign since the low-power x86 core made its debut in 2008.

The biggest surprise: Intel added out-of-order execution but removed Hyper-Threading. In the former technique, the processor reorders program instructions to avoid stalling when an instruction cannot immediately execute—for example, when an instruction must fetch data from memory. The latter technique avoids stalls by switching to a different instruction stream, which may be from another thread in the same program or from a different program.

Essentially, these are two ways of doing the same thing. Why choose one over the other? Single-thread code still dominates most software, even though programmers have been writing more multithreaded code to take advantage of multithreaded CPU cores and multicore processors. Intel claims that Silvermont executes 50 percent more instructions per clock cycle than today's Atom cores—an impressive improvement. When that gain is multiplied by the latest 22-nanometer FinFET technology, the total throughput more than doubles.

Bigger processors can use both instruction reordering and multithreading to boost performance. But Silvermont is designed for smartphones, tablets, convertible PCs, communications equipment, auto infotainment systems, and microservers. Even with 22nm FinFET technology, implementing both techniques would have burned too much power, so Intel compromised in favor of single-thread performance.

As transistors shrink to 14nm and smaller dimensions, both techniques may fit within Intel's power budget for Atom. I expect future designs to restore multithreading.

When Silvermont processors begin appearing this summer, benchmarks will reveal if Intel made a wise trade-off. But interpret those scores carefully. Do they reflect the real-world software you'll run most of the time? The Rolling Stones got it right: You can't always get what you want, but sometimes you get what you need.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.



Thomas McDonald
Game Theory

THE CAUSE OF MY JOY

THE STRENGTHS of computer gaming are found at the extremes. It does two things very well: It enables hardcore users to get the best possible performance out of high-end games, and it allows small developers to deliver individualistic and quirky projects direct to users.

Both of these qualities are important, but the future of PC gaming as a unique platform is found in the latter rather than the former.

"Unique platform" is the operative phrase there. The console tail is wagging the design dog, and as even consoles gets battered by mobile gaming and the economy, we can expect further shifts.

People played PC games because they *weren't* console games. They were different, mature, sophisticated, *fresh*. You cannot measure the level of my indifference to the idea of yet another Call of Duty game, but show me a rough freebie like Slender and I get excited.

Is Slender any good? By most traditional standards, probably not, but it works because it does what it sets out to do. A slight game element provides some drive, but it's really just a mood piece. Its goal is to create mounting tension and then scare the hell out of you. And it does that in spades. It's uneven and flawed and brilliant at what it does, like the best kind of indie horror movie.

PC gaming is overflowing with this kind of small greatness. Monster Loves You is a charming interactive story-cum-adventure game that is unlike anything I've seen. Reus performs a dandy mashup of side-scroller, puzzler, and god game. And can you imagine the design-by-committee process of a big publisher turning out the kind of dazzling and detailed personal vision found in Monaco, the best game of the year so far?

Antichamber, Dust, Night of the Rabbit: All of them have flaws, yet all of them have something else: a unique and personal way of looking at the world, a different design sensibility, a *pulse*. It's what PCs do best.

Thomas L. McDonald is Editor-at-Large of Games Magazine.

Wearable Computing Gets an Upgrade

News blog TechCrunch reports that Munich-based tech company Metaio, which specializes in "augmented reality" devices like head-mounted glasses that recognize hand motions and project objects into 3D space in front of the user, has appointed professor Steve Mann, a renowned "wearable computing" and cybernetics researcher, to act as its chief scientist. Metaio's founder Meron Gribetz cited Mann's knowledge of miniaturization and "mediated reality," a blanket term for a portable computing device that interacts with the user's surroundings to manipulate their awareness of it. Mann has been developing the "EyeTap," a progenitor of Google Glass, since the 1980s. He holds a PhD from MIT and has pioneered a number of technologies ranging from high-dynamic-range photography to the hydraulophone musical instrument. **–TM**

Adobe: No More Boxed Copies

Adobe announced in May that it will be discontinuing boxed copies of all of its Creative Suite, which it uses to bundle its popular Photoshop, Premiere, and other content creation programs. Instead, the company is switching the package to Creative Cloud, which will only be available via subscription from Adobe's website. $50/month will get you everything, while $20/month gets you individual programs. Current Creative Suite owners are eligible to receive a $20/month discount on the full package, for the first year. So there will be no Creative Suite 7, but previous CS releases will continue to get patches and technical support. **–PL**



Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

WINDOWS START BUTTON
Due to make its triumphant return in Windows 8.1.

AMD
Beleaguered firm scores massive $3B (estimated) Xbox One deal.

FLICKR
A redesigned UI and 1TB of free storage earns Yahoo kudos.

SAMSUNG
Touts 10 million Galaxy S4 phones sold in first month.

TRAGEDIES

WINDOWS START BUTTON
Reports say the button will only take you to Modern UI.

MICROSOFT
Xbox One launch met with widespread scorn.

WINDOWS 8 MODERN
Study finds average users opens just 1.4 Modern apps daily.

LULZSEC HACKERS
Sentenced to serve prison time. Gee, what a tragedy.

Quinn Norton
Byte Rights



INTERNET FEAR FACTOR

SECURITY ON THE Internet is terrible. That's always been true, but it's wildly obvious these days. Right and left, people are losing their passwords, ending up in botnets, and some days it seems like you might as well post your bank details on Pastebin, just to get it over with.

Embarrassingly, a pro-Syrian government group called the Syrian Electronic Army took over the Twitter accounts of the Associated Press, FIFA, and even The Onion. After this, Twitter finally rolled out something called two-factor authentication to make its users more secure.

Website two-factor authentication works with something you know (a password) and something you have (a mobile phone). It's not perfect, especially if you don't have or want to connect a phone to your Twitter account. But if you can use it, you should. If you get tricked out of your password, someone still has to mug you for your phone before they can tweet names for human genitalia repeatedly from your work account. It's available for Google, Dropbox, Yahoo, probably your bank, and many more.

It's a long time in coming. Accounts are compromised all the time. Innumerable people have clicked bad links only to be tricked into giving up their logins, but the techniques to prevent this are decades old—so why is it still on the rise?

The truth is, many companies don't care about securing their customer data because they don't have to care. If they get hacked, they are considered the victims, not you—no matter how badly they secure your information. In fact, until California passed a disclosure law 11 years ago, companies didn't even have to tell you that your data was lost.

We have to demand better from software. But the first step is using what we have now—and turning on two-factor authentication for our accounts.

Quinn Norton writes about copyright for Wired News and other publications.

Nvidia Backs Windows RT

Things have not been looking good lately for Windows RT, the version of Microsoft's flagship operating system that runs on a low-power ARM chip instead of a conventional x86 CPU. The reasons are controversial and manifold, as are the actual sales numbers, but one would not be shocked if Microsoft pulled the plug on RT and shifted everything to the Intel-based Surface Pro. However, not everyone is pessimistic. Nvidia stepped into the ring recently to defend RT—Microsoft's RT tablet, as well as a couple of others, use Nvidia's Tegra 3 chip at the core of their hardware.

Rene Haas, Nvidia's vice president of computing products, said in a quarterly call to investors that they were fully on track to put the Tegra 4 in the next wave of Windows RT tablets. He believes that the new chip would allow RT devices better battery life and less bulkiness, perhaps making them more appealing to people who've grown used to using their smartphone as the go-to mobile device. Haas believes that the market is at the earliest stages of a long-term transition from desktops to mobile, so it's not bad that the sales numbers are initially underwhelming.

However, it's not clear how much the actual device manufacturers share his sentiment; if they do not, then it's academic, and Nvidia's Tegra chip will have to fight over the Android space with some pretty entrenched competition from Qualcomm and Samsung.

In March, Nvidia's CEO Jen-Hsun Huang expressed disappointment in RT's sales figures but believed that Microsoft would "ultimately get it right." **–TM**



802.11ac Wi-Fi Pushed to 1.7Gb/s

Tech news site Ars Technica reported in May that a company called Quantenna has reached Wi-Fi speeds of 1.7Gb/s (about 216MB/s) over 802.11ac. 802.11ac is the next step from 802.11n, bringing us from 150Mb/s to a theoretical max of 433Mb/s per single link. Quantenna achieved its feat by combining four links over one connection. In practice, a user's results would most likely fall short of that since Wi-Fi requires constant re-sending of packets to achieve the same reliability as a wired connection. The company's QSR1000 chip uses "Multi-user MIMO" to run multiple Wi-Fi connections at once, and combines them into a single stream. Quantenna expects the chip to be available in Q3 this year. **–TM**

Ohio to Ban Internet Cafes

Media outlets were abuzz with word that the Ohio state senate has decided to ban Internet cafes, which are commonly used for multiplayer gaming and catching up with distant friends and relatives. The senate regards them as havens for illegal gambling. Ohio has four approved casinos and racetracks but otherwise outlaws games of chance. An undetermined number of cafes were allegedly using sweepstakes to get around the law. This will lead to the closure of an estimated 800 business and the loss of 6,000 jobs.

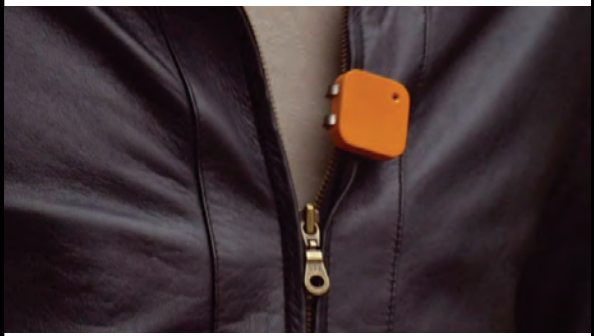
The bill had yet to be signed by Governor John Kasich as we went to press, but he is unlikely to veto it. **–TM**

THE LIST

7 PIECES OF WEARABLE COMPUTING

7 MEMOTO CAMERA

This clip-on camera lets you take photos continuously, without effort—there's nothing creepy about *that.*



6 GOOGLE GLASS

Run apps via voice command, while looking like a major a-hole....



© Giuseppe Costantino

5 OCULUS RIFT

Immerse yourself even more deeply in games with this head-mounted display, which also manages to make Google Glass look cool by comparison.





4 NIKE FUEL BAND

Nike's Fuel Band is among many fitness bands that can track your run, walk, or boxercise workout.



3 PEBBLE WATCH

When you can't be bothered to lift your smartphone from your pocket, the Pebble Watch puts apps upon your wrist.



2 TAGG PET TRACKER

A venturesome dog or cat can't stray too far from home with this GPS collar.

1 SCOTTEVEST

With pockets galore for holding all your electronics, this is either a godsend for nerds or a modern-day chastity belt.

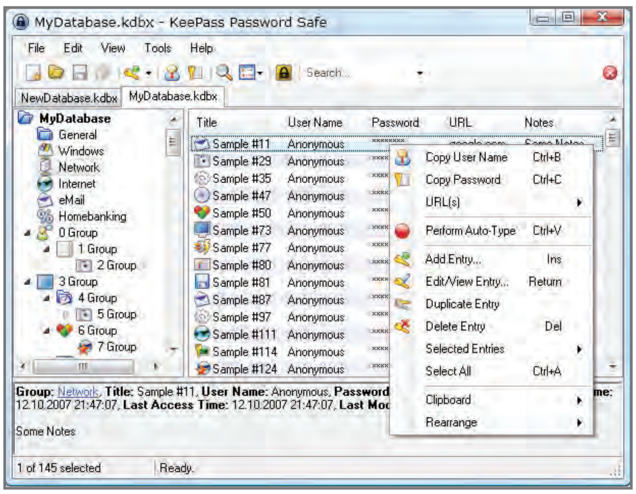


HEAD TO

BY KATHERINE STEVENSON

LastPass vs. KeePass

For years, we've been touting the virtues of KeePass Password Safe, a free open-source program for storing all your website passwords and associated notes behind a single master password. And to synch KeePass across multiple machines, we've been recommending that readers store the encrypted database on Dropbox. However, we got to wondering whether the popular browser-based password manager LastPass was a superior, one-stop solution. So this month, we invited the two free password trappers to duke it out for bragging rights.



Right-click any entry in your KeePass database and you can launch the URL and auto-fill your login info.

Round 1: Setup

KeePass is a very straightforward database. After selecting your master password and/or key file, you simply start adding entries by typing or copying-and-pasting URL, user name, password, and any relevant notes into the designated fields. There are options for groups and sub-groups, as well as icons to aid in organization of your database.

You can enter all of that same info into your LastPass Vault in a similar manner; but with the browser plugin installed, you're also able to capture URLs and login info as you visit your various favorite sites, via the LastPass icon that resides in your browser bar. This makes LP that much more convenient for populating a comprehensive database of all your online sites and accounts.

Winner: LastPass

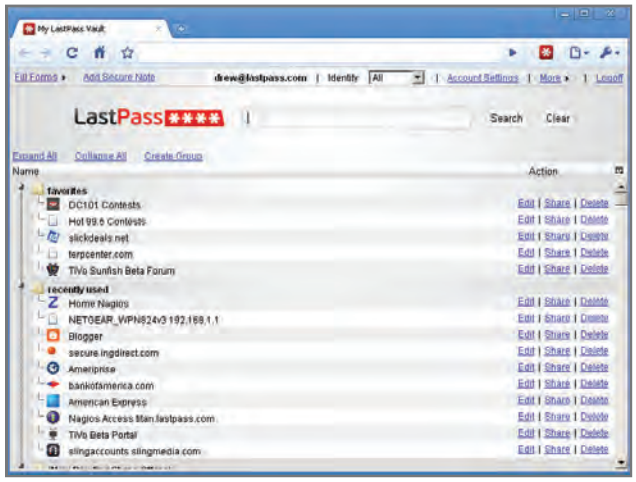
Round 2: Security

Your KeePass database is kept secure behind either a master password or a key file (that you keep on a USB drive, for instance), or both. The entire database is encrypted using AES 256-bit encryption by default, or Twofish 256-bit encryption, if you prefer. Every password is automatically measured for quality, and a random password generator will churn out a password to your specification. Finally, the open-source nature of KeePass means its code, and its integrity, can be scrutinized by anyone, adding a degree of confidence.

LastPass also uses 256-bit AES, and reportedly encrypts and decrypts your data locally on your PC, so it's unusable from LastPass's servers. Like KeePass, LastPass will tell you if a password needs improvement, and generate a random password for you if you like, but that feature isn't directly tied to your Vault entry, making it a bit less convenient, so KeePass wins this round by a hair.

Winner: KeePass

HEAD



Using the browser plugin, you can populate your LastPass Vault by saving data as you visit all your favorite sites.

Round 3: Auto-Fill

Both KeePass and LastPass offer auto-fill options that can make launching and signing into your websites very easy. In KeePass, you first right-click a database entry to Open URL, and then right-click the entry again to Perform Auto-Type—which will insert your login credentials into the appropriate fields. By default, username and password are entered. For multi-page logins and other special instructions, it's possible to create command strings, but this obviously takes time and trial.

With LastPass, a single click on a Vault entry will take you to a URL and log you in, in one fell swoop. In theory, you can auto-fill on a site with multiple login pages by saving the data entered on each page, but we were unable to get this to work properly and also found it created confusing clutter within our Vault. We appreciate, however, that LastPass is capable of automated form filling, for, say, address and credit card info.

Winner: LastPass

Round 4: Use Across Multiple Devices

On the surface, the browser-based LastPass might seem to have the advantage here. After all, you can access your password vault from any machine that's connected to the Internet—and any changes you make to your data are stored in a single place on the cloud. But with KeePass stored in a cloud drive, such as Dropbox, you have that same functionality, as long as you have the program installed on whatever machine you're using, or you launch it from Portable KeePass on a USB drive (incidentally, to get all of LastPass's functionality, such as Auto fill/Auto login, you need to have the browser plugin installed). What's more, KeePass offers a number of Android and iOS ports for free, so you can also access your passwords from a smartphone. To get LastPass on a smartphone you need to pay $12 a year for the Advanced version.

Winner: KeePass

Round 5: Longevity

As convenient as these programs make it to store your passwords, it still takes time to get your database set up just right for maximum efficiency, so it's important to consider the long-term prospects of each solution. KeePass lives on your computer, so it's not subject to the failings of a remote server. With LastPass, however, a locally cached copy of your passwords is stored on you PC by default when you use the LastPass plugin. Both programs offer export options for backup purposes and the ability to import into another program if the need arises—although, we had a much easier time importing our KeePass data into LastPass than we did importing LastPass data into KeePass, for what that's worth. We also must point out that KeePass, being an open-source utility, is less vulnerable than a business-based solution, giving it the edge over LastPass.

Winner: KeePass

And the Winner Is...

The fact is, if you want to keep your personal info from getting into the hands of every Tom, Dick, and Sergei hacker, you must use distinct logins, of sufficient complexity, for all your various accounts, and a password manager makes that possible. LastPass offers the convenience of being tied to your browser, so you can easily save your entered data and access it from other PCs. But our loyalties still lie with **KeePass Password Safe**, for its open-source nature, free smartphone app, and universal access when stored in Dropbox.

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> HDDs and SSDs
> Ripping Woes
> XP Drivers

Slow Raptor

I just bought a WD Velociraptor WD1000DHTZ hard drive from Newegg. The performance of this drive is not what I expected it to be. I have an Asrock 870 Extreme3 R2.0 motherboard. When I bought this board on Newegg a year ago it was advertised as a SATA6 motherboard, but when I check the Asrock website it states that it is a SATA3 motherboard. Does the underperformance of my Velociraptor have something to do with this, or did I just expect too much?

—Gary Davidson

THE DOCTOR RESPONDS: This is the trouble with SATA's naming scheme: It's confusing. SATA 3.0 is the third revision of the SATA spec, the one that works at 6Gb/s. SATA II is the one that works at 3Gb/s. Your motherboard and the Velociraptor both have SATA 6Gb/s ports, so you have not been misled. Without any solid benchmark numbers it's hard to tell if your Velociraptor is underperforming, but keep in mind that although it is a fast mechanical drive, it's still a mechanical drive and so its random-access times will be a hundred times slower than an SSD's, and its sequential speeds are still half or a third what an SSD's would be. You won't get SSD-like speed from it; all you'll get is a really fast mechanical drive.

Slow SSD RAID

My boot drives are a pair of identical, fairly early 128GB Fujitsu SSDs that are booting Win7 in a RAID 0 configuration, and all my documents and programs are in a pair of 3TB Seagates in RAID 1. Crystal-DiskInfo can't see past the Marvell controller on my Asus P6X58-E Pro but CrystalDisk-Mark's report is a little disappointing, showing sequential read/write of 295MB/s and 116MB/s, respectively. Would I get similar results if these SSDs were stand-alone? My machine is completely ready in one minute from a cold start. Booting from the platter disk that I cloned takes 4.5 minutes.

—Dave King

THE DOCTOR RESPONDS: The 6Gb/s Marvell 9128 SATA controllers on X58 boards are not very fast, at least not compared to the Intel native 6Gb/s controllers from Sandy Bridge and later chipsets. This is partly because they connect to the motherboard via a single PCIe 2.0 lane. Secondly, your RAID controller can't pass Trim commands from the OS through to the drives, so they are slowing down as they run out of fresh sectors, though if those are SandForce drives, as the Doc suspects, the onboard garbage-collecting algorithms should help a little.

If you really want faster performance, you'd actually be better off cloning your RAID 0 to a single 6Gb/s SATA SSD, or re-creating your array using a PCIe RAID card that uses four or more lanes. That said, there's no need to take drastic action if you're happy with the current speed of your drives.

Movin' on Up

If I have a 20GB boot drive, can I move the stuff on it to a bigger drive? I read that cloning even copies the partition. So if I cloned the 20GB drive to a bigger one, the bigger one would act as a 20GB hard drive. How do I get past this?

—Joseph

THE DOCTOR RESPONDS: You can clone that 20GB drive to a bigger one, then increase the partition size to take up all the empty space on that larger drive. There are several ways to do this, but EaseUs ToDo Backup Free (www.todo-backup.com) is a good one-stop solution that makes it pretty easy. It'll let you clone your existing drive image to a larger one and adjust the partition size, either as you clone it over or afterward.

Can't Rip It

I have AnyDVD HD and Hand-Brake. I want to back up my movies but I am having issues with HandBrake: No matter what settings I choose, Hand-Brake always makes the file 4GB and it is never playable. Any help or guidance on what my settings should be would be great.

—Karl

THE DOCTOR RESPONDS: Karl, first, make sure you have the latest version of AnyDVD HD as well as the latest build of HandBrake. You might want to look for firmware updates for your optical drive, as well. You also didn't say what player you were using. The Doc recommends VLC Player (www.videolan.org) for a free player or PowerDVD 13 (www.cyberlink.com) for a paid, but prettier player. You didn't say what operating

↘ submit your questions to: doctor@maximumpc.com

system you were running or what file system you're writing to. If you are running, say, Windows XP on a hard drive that is formatted with FAT32, you should know that FAT32 has a maximum file size limit of just over 4GB. A HandBrake encode of a 1080p Bluray will typically exceed that size. When HandBrake hits the file size limit of FAT32, it may just stop the encode, leaving you with a video that won't play because the file is essentially corrupt.

We Blame Apple

I just finished building a rig that dual-boots OS X and Windows 7. The system in general works just fine, but I have one problem that's been nagging me for the past week: my BIOS. For the first three boots or so on my system, the BIOS startup screen came up cheerfully for two seconds, and then went directly to my boot loader. Next boot, the startup logo decides to stay around for another 20 seconds, until my internal speaker beeps, signaling POST has finished. I'm rocking a Gigabyte Z77X-UDH5 Rev. 1.1 board, and I'm pretty disappointed to see my boot times rising from 10 seconds to around 30. I checked the debug LED codes, and found out that the system was hanging on code 64, or "CPU DXE initialization has started." I have tried updating, resetting, and adjusting the BIOS with no luck. If I want better boot times, would I need to RMA it?

—Derek Werbowy

THE DOCTOR RESPONDS: Contacting Gigabyte support for help is a good idea but there are a few other steps you might want to take. You've updated the BIOS, so you're good there. First, disconnect any external drives or USB devices. External USB devices can on occasion play havoc with boot times and may react differently depending on the USB port they're in.

Still whacky? Make sure all of your mobo power connectors and SATA connectors are firmly connected. You may even want to try to unplug and replug them until you are sure they firmly in place. Reset the CMOS manually, or remove the coin cell with the system PSU switched off for 10 seconds. Before you do that, make sure you take detailed notes on your UEFI settings.

Now, try reseating all of the RAM, and if that doesn't make a difference, try running each DIMM individually. If that doesn't work, start unplugging SATA drives to see if the system is maybe hanging on one of the drives. Your last resort is to consider a CPU reseat, as well.

XP Drivers on New Mobos

I am using an older AMD computer running WinXP and I want to try building a new one all by myself. Just as I was ready to order the parts, my son said, "Whoa, if you want to keep WinXP" (which I do), "the motherboard must support WinXP." I think he mentioned the chipset. Does the Gigabyte Z77X-UP4 TH support WinXP? If not, which Z77 motherboard still supports WinXP? I plan to use an Intel i5-3570K CPU and GeForce GTX 660 GPU.

—George Pieper

THE DOCTOR RESPONDS: As long as there are Windows XP–compatible drivers for your motherboard, you'll be fine. According to Gigabyte's support site (www.gigabyte.us), there are indeed WinXP drivers for that mobo, so you're good to go. If you want to do any gaming with that computer, you should consider upgrading to Windows 7 or 8. If you stick with Windows XP, you won't be able to take advantage of the DirectX 11 capabilities of that GeForce GTX 660.

BECOME A HARDWARE EXPERT

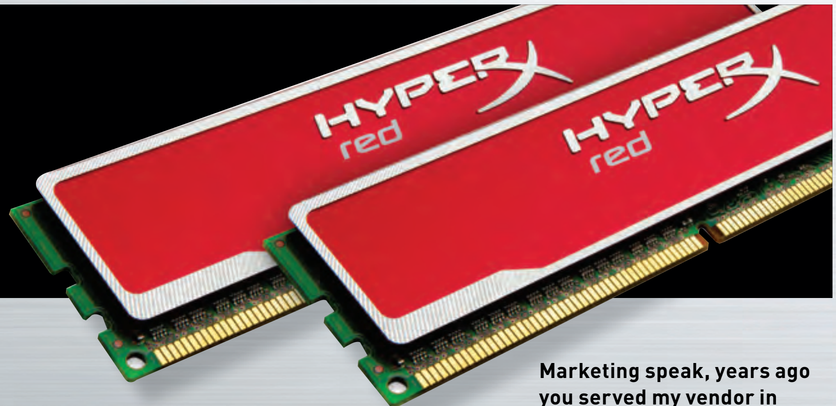


OR HOW TO NAVIGATE YOUR WAY AROUND A PRODUCT BOX WITH TOTAL SELF-ASSURANCE

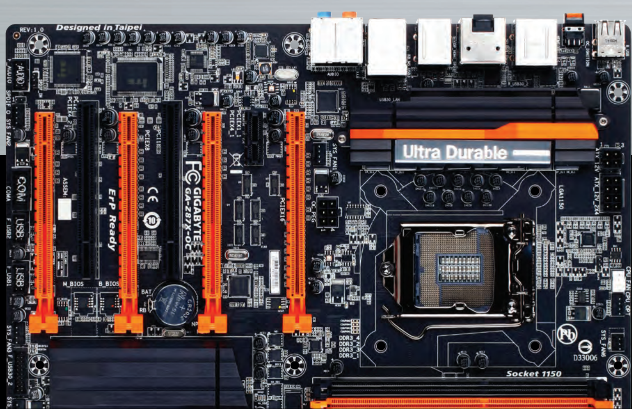
BY GORDON MAH UNG AND JOSH NOREM

Knowledge is power, and when it comes to PCs that's especially true, because only by knowing how your components' specs actually affect performance can you get the maximum power you need for the type of computing you do—and avoid being seduced by features that sound impressive on the box but won't do squat to improve your experience. Knowing your stuff has other benefits, too. An in-depth understanding of what makes all your parts tick enables you to better troubleshoot problems, upgrade in ways that make sense, and converse with other nerds in your own secret language. Turn the page to begin your crash course in PC spec-speak.



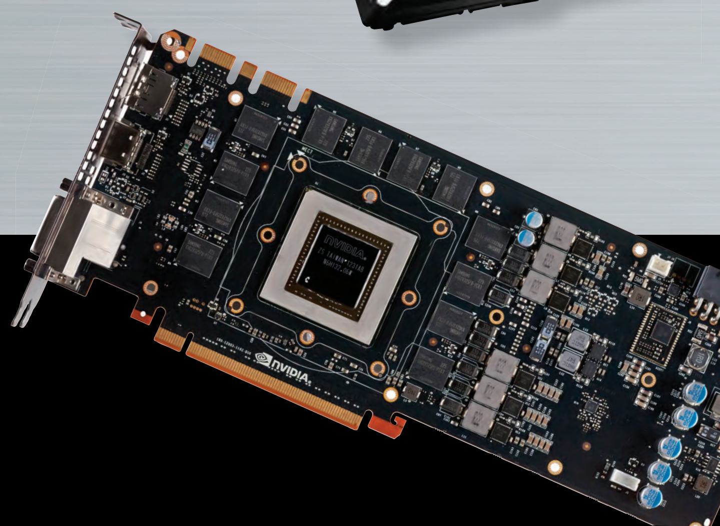


Marketing speak, years ago you served my vendor in the Megahertz Wars. Now he begs you to help him in the struggle to sell people new hardware. Help me Specsmanship, you're my only hope.









CPU

Just how many cores and how much cache do you need? We'll help you answer those questions and others with cool confidence



SOCKET

There are two kinds of buyers: Those who will never upgrade a CPU and those who actively plan for it. For the former, even a CPU welded to the motherboard won't matter, but upgraders who want to use a system for years need to pay attention to the socket, as it's one of the primary factors limiting your upgrade options. On Intel, there are three sockets to choose from: LGA2011, LGA1155, and the new LGA1150. Of the three, LGA1155 has the least amount of life left in it, as it will be slowly phased out in favor of the new LGA1150 platform. We know from Intel roadmaps that LGA1150 and LGA2011 are good for at least another couple of years. On AMD, AM3+ offers a superb assortment, from budget dual-cores all the way to eight-core chips, with the company's new Piledriver chip even slotting into this old socket. The company's FM line isn't quite as stable. FM1 didn't go very far, but the company's FM2 looks like it might have longer legs. The thing is, FM2 processors—or rather, APUs—aren't aimed at the type of user who upgrades every year. We suspect that most FM2 buyers will use the platform for a couple years and then buy a new system instead of upgrading. For long-haulers, we recommend AM3+, LGA2011, and LGA1150. If you don't care about doing an upgrade, go with whatever CPU you want.

CORE COUNT

Core count is the new clock speed. That's because as consumers have been trained not to look at megahertz anymore as a defining factor, vendors have turned to core count as an emotional trigger. Two is better than one, four is better than two, and six is better than four.

Here's the deal, though: More cores are indeed better—but only if you truly use them, and really only when compared within the same family of chips. For example, to assume that an eight-core AMD FX part is faster than a six-core Intel Core i7 part would be flat-out wrong. Likewise, to assume that a PC with a six-core Intel Core i7 will be faster at gaming than a quad-core Core i7 is also likely wrong. To make things more complicated, Intel uses a virtual CPU technology called Hyper-Threading to push its CPUs. Some chips have it, some don't.

So, how do you figure out what you want? First, look at your workloads. If you're primarily a gamer who browses, does some photo editing, and word processing, we think the sweet spot is a quad-core chip. Those who encode video, model 3D, or use other multithreaded apps, or even many apps simultaneously, should consider getting as many cores as possible because you can never have enough for these workloads. A good bridge for folks who encode video only occasionally, though, is a quad-core chip with Hyper-Threading.

CLOCK SPEED

Remember the Megahertz Myth? It's what we alluded to above. It arose from the understanding that clock speed didn't matter, because a 2GHz Pentium 4 was barely faster, if at all, than a 1.6GHz Athlon XP. Years later, that generally remains true. You really can't say a 4.1GHz FX-8350 is going to smoke a 3.5GHz Core i7-3770K because in a hell of a lot of workloads the 3.5GHz Core i7 is going to dominate. Nevertheless, we have issues when someone dismisses megahertz outright as an important metric. We don't think it's handy when looking at AMD vs. Intel, but when you're looking within the same family, it's very telling. A 3.5GHz Intel chip will indeed be faster than a 2.8GHz Intel chip. The same applies among AMD chips. So, consider clock speeds wisely.

CACHE

When vendors start looking for ways to separate your cash from your pocket, clock speed and core count are their first line of attack. If those features don't get you, we've noticed that the amount of cache is the next spec dangled in your face. Choices these days run from 8MB to 3MB or less. First, you should know that in many cases, the chips themselves are often the same. When validating chips, AMD and Intel will weed out defective chips. If a chip has, say, 8MB of L2 cache and a bit of it is bad, it's sold as a chip with 6MB of L2 cache, or 4MB of L2 cache. This isn't always true, as some chips have the cache turned off or removed to save on building costs.

Does cache matter in performance? Yes and no. Let's just

Your CPU choice should be based on your workload and not what you read about.



say that a large cache rarely hinders performance, but you quickly get to diminishing returns, so for many apps, a chip with 8MB of L2 could offer the same performance as one with 3MB of L2. We've seen cache matter most in some bandwidth-sensitive tasks such as media encoding or compression, but for the most part, don't sweat the difference between a chip with 4MB of L2 vs. one with one 3MB of L2.

INTEGRATED GRAPHICS

Integrated graphics are likely one of the biggest advances in CPUs in the last few years. Yes, for gamers, a discrete video card is going to be faster 105 percent of the time, but for budget machines, ultra-thin notebooks, and all-in-ones, integrated graphics are usually all you get, and there's a world of difference between them. Generally, AMD's integrated graphics chips lead the way over Intel's older generation of Ivy Bridge and Sandy Bridge chips. It's like, well, AMD is the Intel of integrated graphics and Intel is the AMD. Intel's latest Haswell chips make it far more interesting, though, as the graphics performance has increased greatly. Then again, AMD has also recently released its new APUs with Radeon HD 7000 graphics. The spec that matters most on integrated graphics is the number of graphics execution units and clock speed. More EUs mean better performance, as does higher clock speeds.

When to Run Aftermarket Cooling



The Cooler Master Hyper 212 Evo is a low-cost, worthy upgrade over stock—if you need it.

Let's get it out in the open: Stock CPU coolers really aren't as bad as people make them out to be. Sure, we all scoff at them, but the truth is that Intel and AMD spend considerable money on the design and certify them to work with their CPUs in all types of environments. For the vast majority of people, the stock cooler is just fine.

But you're not the vast majority of people. Sadly, today, if you can even open up the case, you're an enthusiast. Sure, there are applications for the stock cooler, such as an HTPC or a small box that won't be overclocked, but we like to think of the stock cooler as the minimum spec you should run. It's fine, but it can be greatly improved upon.

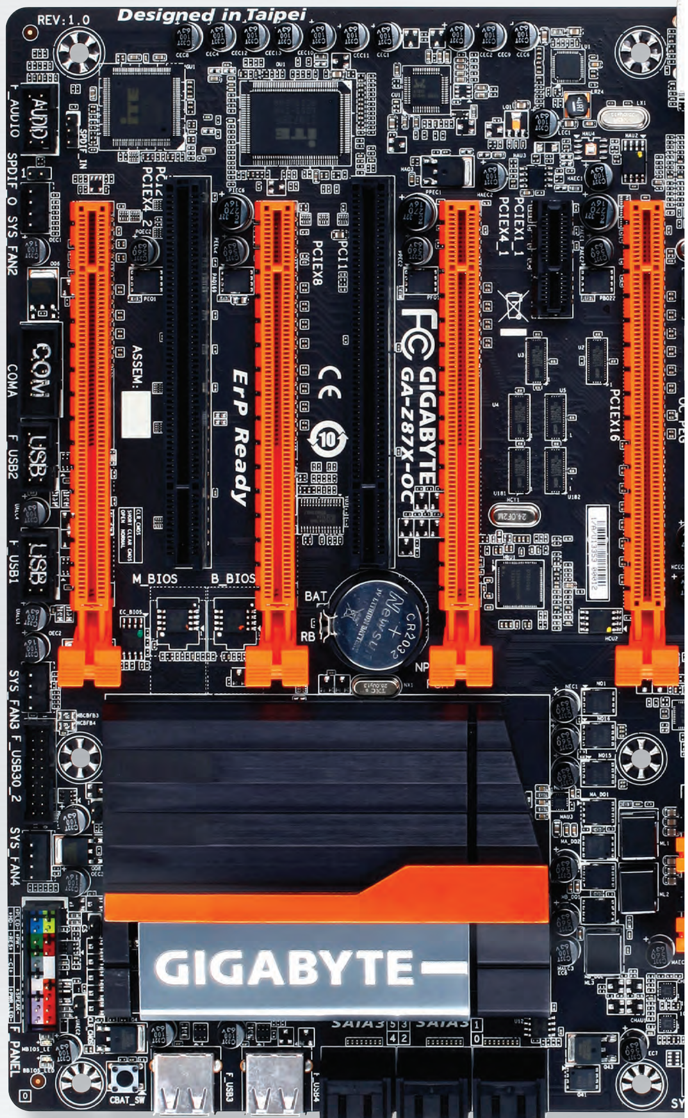
Obviously, if you're an overclocker, a beefier heatsink is a foregone conclusion, as heat is one of the worst enemies of a successful overclock. Swapping out the stock cooler for an aftermarket model is almost guaranteed to net higher or more stable overclocks than you can hit with the stock cooler.

Even if you don't overclock, an aftermarket cooler can be a worthwhile addition. Since they can dissipate more heat than a stock cooler, and the fans are typically larger, the fan RPMs are usually lower, thus quieter.

Closed-loop liquid coolers are also a good option, as they require zero maintenance and the risk of a leak is extremely low. Liquid coolers are also quite affordable today and easily outstrip the vast majority of air coolers. One thing you'll need to keep in mind is that closed-loop liquid coolers aren't always the quietest option out there, though.

Motherboard

Knowing your way around a motherboard is a distinguishing characteristic of a PC nerd. Let us help orient you



FORM FACTOR

The form factor of a motherboard is its physical dimensions. The most popular today is the 18-year-old ATX form factor. The two other popular sizes are the smaller microATX and Mini-ITX. Intel tried and failed to replace ATX with BTX. Two additional form factors are the wider Extended-ATX and XL-ATX. XL-ATX is not an official spec but generally denotes a longer board to support more expansion slots. For an enthusiast, ATX will cover about 90 percent of your needs. Besides offering the most flexibility in expansion, it's also where you the get the widest range of selection. You can get budget all the way to the kitchen sink in ATX. MicroATX is usually reserved for budget boards, but there are a few high-end boards in this form factor these days. Mini-ITX is exciting, but the limited board space makes for few high-end options in this mini size.

SOCKET

As we said in our CPU write-up, your motherboard's socket dictates all that the board will ever be. If, for example, you buy a discontinued socket such as LGA1156, your choice of CPU is greatly limited. The most modern sockets today are LGA1155, LGA1150, LGA2011 for Intel, and AM3+ and FM2 for AMD. For Intel, LGA2011 and LGA1150 have the longest legs. Though still useable, the sun is now setting on LGA1155 boards. AMD is actively supporting AM3+ and FM2, but there is talk of a new socket to replace FM2.

CHIPSET

The chipset on a motherboard refers to the "core logic" and used to entail multiple chips doing several jobs. These days, the core-logic chipset is down to one or two chips, with much of the functionality moved into the CPU. Chipsets manage basic functions such as USB, PCIe, and SATA ports, and board makers throw on additional controllers to add even more functions. You should pay special attention to the chipset if you're looking for certain functionality, some of which is only possible on newer chipsets. The P67 chipset, for example, did not support Intel's SSD caching, but the Z68 did. Current high-end chipsets from Intel include the Z77, Z87, X79; from AMD you have the A85X, 990X, and 990FX.

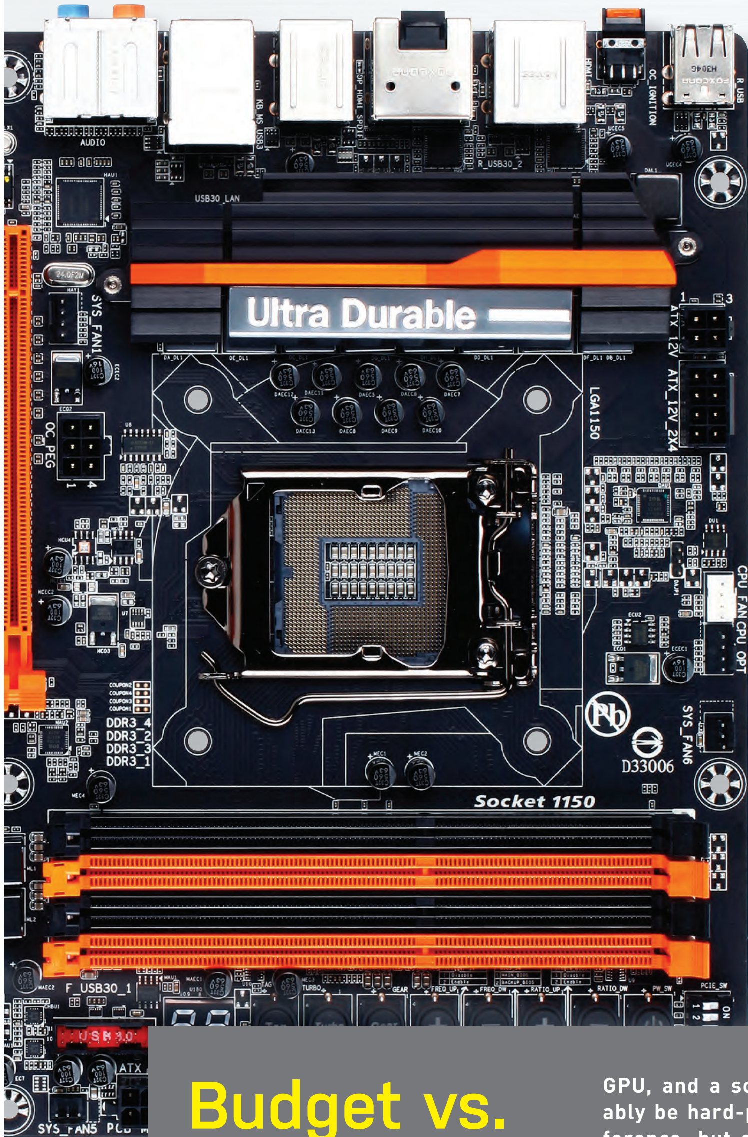
SLI/CROSSFIRE SUPPORT

The vast majority of gamers never run more than one video card, but it's always nice to know you have the option. AMD's multicard solution is CrossFire for two boards, and CrossFireX for more than two. For its part, Nvidia has SLI for two-card setups, tri-SLI for three cards, and four-way SLI for four cards. We won't judge the relative merits of each system, as this isn't the place for it. Most boards that offer one, also offer the other, but don't assume a CrossFire board will support SLI. Read the specs ahead of time if you plan to run multiple cards.

PORTS

One of the main differences between a high-end board and a low-end board is the ports. High-end boards tend to have ports galore, with FireWire, additional USB 3.0, digital audio, eSATA, and Thunderbolt added on to convince you that board B is better than board C. How many ports, and what type, do you need? That is something only you can answer. If you still run an older DV cam that needs FireWire, having the port on the board for "free" is always nice. Thunderbolt is also an incredibly cool, forward-looking feature, but is very pricey. If you never use it, you will have paid for nothing. These days, we say eSATA and FireWire aren't needed. What we want, mostly, is a ton of USB 3.0 ports. The ultimate board today might be one with nothing but USB 3.0 ports, if you ask us.

There are degrees of enthusiast computing and motherboards to accommodate all scenarios.



SLOTS

If you see a board with tons of those long PCIe slots, don't assume they're all hot. PCIe slots can be physically x16 in length (that means 16 lanes) but only x8 or x4 electrically (which means the data is limited to x4 or x8 bandwidth). Cheaper boards may even disable some onboard devices when run in multi-GPU modes, while pricier boards use additional chips to spread the available bandwidth around and keep the devices running. AMD's 990FX and Intel's X79 don't have the limited bandwidth of the Z77 or Z87 chipsets, so if you need lots of slots, you'll want to opt for those chipsets. Unfortunately, Z77 and Z87 are where you find more PCIe 3.0 support. PCIe 3.0 doubles the effective bandwidth over PCIe 2.0, but it's still not officially supported on X79, and only newer 990FX boards support it now. Confused? Our advice is that if you really need to run high-bandwidth add-in boards for video capture or RAID applications, ask the manufacturer what motherboards they have certified for it first.

POST LED

This is a tiny segmented LED on the board that displays the POST code of the motherboard while booting. It may seem trivial, but POST LEDs are a godsend when things go sideways on a machine. If all other things were equal, we'd take a board with the POST LED over one without it.

BACKUP BIOS

A backup BIOS stores a duplicate BIOS on the motherboard that can be restored should the BIOS get corrupted. We think it's a nice feature but a corrupt BIOS is pretty rare. Nevertheless, it's probably better to have a backup BIOS and not need it than to need it and not have it.

EXTRA FEATURES

Wireless, premium sound, fan controls, and headers galore are the special features board vendors use to hook you. You might dismiss them as unnecessary features, but so are the power windows and multi-speaker setup in your car. Certainly some extras aren't needed, such as onboard Wi-Fi on a desktop box that will live on Ethernet, but fan control, such as Asus's excellent FanXpert II, is worthwhile, as are premium audio circuits.

Budget vs. Premium: Is It Worth It?

In a given chipset family—say, Z77—it's easy to find a motherboard costing $110 as well one running $379. Both use the same chipset, so are they the same? It depends.

If you intend to socket in a non-overclocked Core i7-3770K, run one GPU, and a sound card, you'd probably be hard-pressed to tell the difference, but don't assume that premium boards are just a gimmick to rip you off. High-end motherboards aren't just anodized a different color and slapped a higher price. The $110 board will be pretty much a strippo option, with no multicard support, minimal ports and slots, and a design that's not made for high overclocks. Yes, you might be able to overclock the budget board, but the voltage regulator modules and chipset cooling are likely to limit you. High-end overclocking boards are truly designed for the sport, with direct voltage readout hard points. And yes, fancy new technology such as Thunderbolt, additional USB 3.0, and SATA controllers cost more money. Even the software suite on the budget board will be pretty stripped down.

Still, the truth is that most of us will neither be overclocking with liquid nitrogen nor going ultra-budget. That's why board vendors offer a dizzying array of selections between the rock-bottom and high-end. We think the $175 range gets you a pretty decent board, generally.

SSDs

SSDs have a lot of complicated technology inside their waifish 2.5-inch shells, so follow along as we demystify it for you

CONTROLLER

The controller is the brains of the SSD, and what governs performance for the most part (along with the type of NAND flash used). The controller uses parallel channels to read and write data to the NAND, and also helps optimize the drive via the Trim command, as well as performing routine garbage collection. Though some companies might license a third-party controller, they always use custom firmware that they have created in order to define the performance of the drive, so two SSDs that use the same controller will still have varying levels of performance in different workload scenarios. While the SSD world used to be somewhat ruled by the LSI SandForce controller, those days have long passed, and we are now seeing the rise of in-house controllers by companies such as Samsung and OCZ.

OVER-PROVISIONING

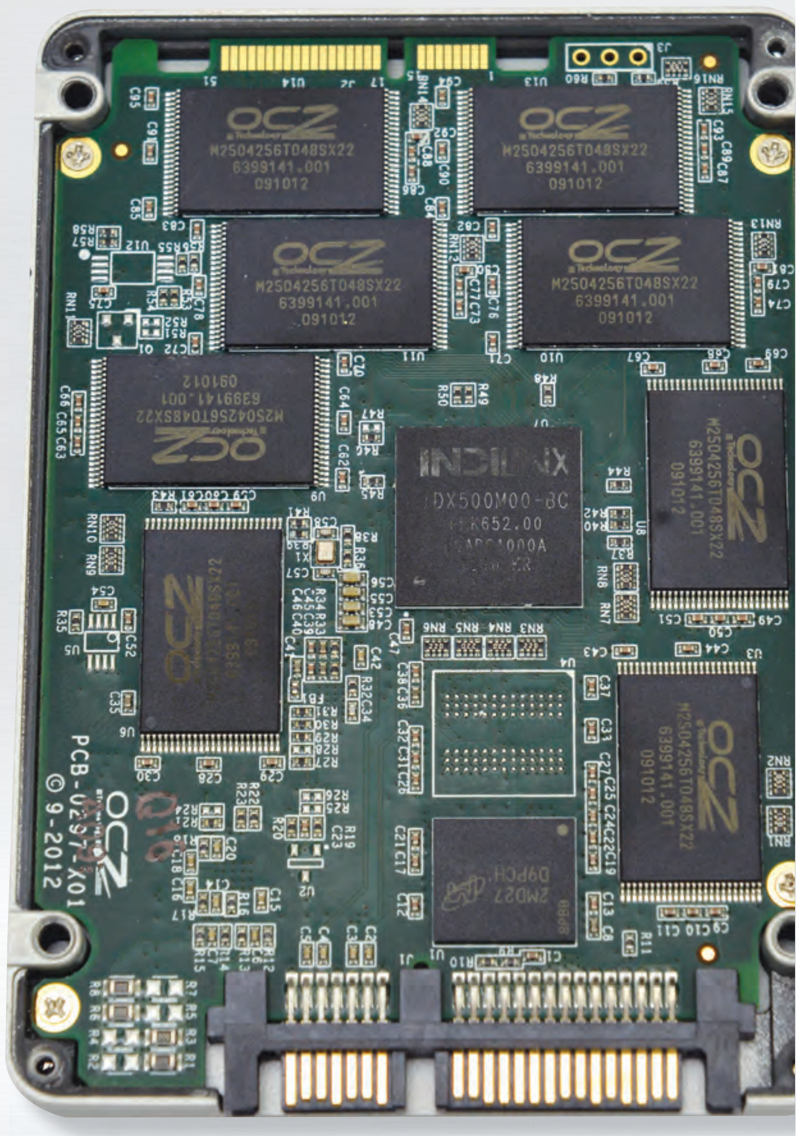
Over-provisioning is a spec you will rarely see explicitly mentioned on a product box, but its presence, or lack thereof, is evident by a drive's capacity. Over-provisioning is simply space taken out of the drive's general capacity and reserved for drive maintenance. So if you see a drive with 256GB of capacity, there's no space reserved, but a drive listed as 240GB has 16GB reserved for over-provisioning. In exchange for that space you get increased endurance, as it gives the SSD controller a lot of NAND flash to use for drive optimization and management. The provisioned NAND can be compared to a swap file used by a mechanical hard drive and operating system, in that it is space reserved to manage the files on the SSD.

NAND FLASH

All SSDs use this type of memory, as it's non-volatile, meaning you can cut off power to it and the data remains in place (mid-data-transfer is another story, though). The opposite is DRAM, which is volatile, so once you shut down your PC, it is deleted. There are several manufacturers of NAND flash, including ONFI/Micro, Samsung, Toshiba, and SanDisk, and all the SSD vendors use them, so while a Samsung SSD obviously uses Samsung NAND, so does the new Seagate SSD, for example, since Seagate doesn't own a NAND fab. Corsair SSDs use Toshiba NAND, and so forth. There's no answer to the question of "who makes the best NAND?" as they all have varying performance characteristics, and it's typically the controller and its firmware that play the biggest role in determining a drive's performance. Good NAND with a crap controller equals crap, so keep that in mind when shopping for an SSD.

MLC, SLC, TLC NAND

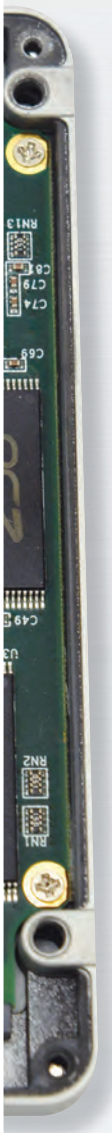
All modern NAND flash is either SLC, MLC, or TLC, which stands for single-, multi-, and triple-level cell, which indicates how many values it can hold in a cell at one time. The most secure, and precise, is SLC, which holds a single value in each cell. Obviously, this is a bit inefficient, but also very accurate, and has high endurance, making SLC NAND ridiculously expensive, and not for consumers (it's for enterprise). Next up is MLC, which stands for multi-level cell, as each cell can hold two values at a time. MLC is used on the majority of SSDs you can buy, as it strikes a fine balance between cost and capacity. TLC flash, which stands for triple-level cell, holds—you guessed it—three values per cell, giving it the lowest endurance of any drive available, with the caveat that it still allows years of usage. Only the Samsung 840 and Intel 335 use TLC NAND flash; the rest of the consumer SSDs available today use MLC NAND.



Here we see the main components of an SSD: NAND flash, controller chip, DRAM, printed circuit board, and SATA connectors.

HDD

Even though SSDs are the cool kids, we still need hard drives for our "multimedia" collections. Here are all the terms you need to know to sound like a pro



SPINDLE SPEED

Spindle speed is the rotational velocity of the platters expressed in rotations per minute (rpm). Faster spinning platters result in lower seek times and improved performance. The most common desktop drives spin at 7,200rpm, but there are also 5,400–5,900rpm desktop drives, which we recommend only for backup purposes given their reduced performance relative to a 7,200rpm drive. There are 10Krpm drives as well, but the rise of much-faster SSDs have largely made them irrelevant in today's market.

PLATTERS

Every hard drive stores data on platters made of glass alloy, with data retained on both sides that's accessed by read and write heads hovering on each side of the platter. The number of platters is something to pay attention to when shopping for a drive, as it dictates area density, or how much data is stored per platter. Right now, 1TB is the maximum platter density available, and it offers improved performance compared to a 750GB platter, all other things being equal. Since the platter has more data on it, the read/write heads have to move around less to pick up data, so we've seen significantly improved performance from drives bearing these super-dense platters.

CACHE SIZE

All hard drives have a bit of onboard memory referred to as cache, and the market has mostly settled on 64MB being the standard. The cache is used as a buffer, in that data is sent to it before being written to the disk. Whatever was last written or read will usually still be in the buffer should you need it again, so it improves performance by making recently accessed data available instantly. This practice of fetching data from the onboard cache is referred to as "bursting" in benchmarks, but in practice it rarely happens, so don't use this number to determine a drive's overall performance. Spindle speed is a much better indicator of hard drive performance compared to cache size.

NCQ

This stands for Native Command Queuing and is technology that helps the drive prioritize data requests so that it can process them in an efficient fashion. For example, if a drive receives a command to go all the way out to the outer perimeter to fetch some data, but then receives a request for data that is closer to its current location, with NCQ enabled, it would fetch the data in the order of closest bits to furthest bits, resulting in faster data transfer. A drive without NCQ would simply fulfill the requests in the order received, which is highly inefficient. NCQ only shows significant gains in a heavily queued workload, however, which typically doesn't exist for home users, but does occur on a web server or some other high-traffic application.



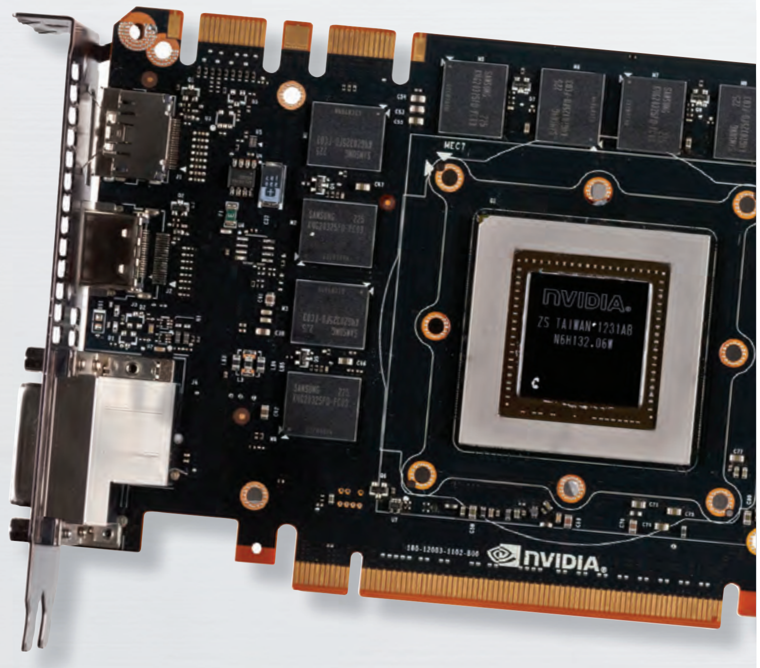
A hard drive uses magnets (lower left) to move the read/write heads (the pointy things), which are both above and below the data platters.

The Scoop on SSD Caching

We all want the speed of an SSD but with the price and capacity of a mechanical hard drive. Obviously that's not possible. However, there is a middle ground, which is using a small SSD as a caching drive for a mechanical hard drive. This allows your most frequently used files (including your OS and boot files) to be cached to the SSD for fast access to them, while less frequently accessed files reside on your hard drive. This actually works quite well in our testing, and to set one up you'll need to either run it off your existing motherboard with any SSD you have lying around, or buy a caching SSD and use the included software to set up the caching array. For Intel users, Z68 and Z77 boards include caching support natively via Intel Smart Response Technology, but users of other chipsets will need to BYO to the party.

GPUs

The world of GPUs can be a scary place fraught with big words, bigger numbers, and lots of confusing nomenclature. Allow us to un-confuse things a bit for you



MEMORY

The amount of memory a GPU has is also called its frame buffer (see below). Most cards these days come with 1GB to 3GB of memory, but some high-end cards like the GTX Titan have 6GB of memory. In the simplest terms, more memory lets you run higher resolutions, but see Frame Buffer for more info.

CORES/PROCESSORS

GPUs nowadays include compartmentalized subsystems that have their own processing cores, called Stream Processors by AMD, and CUDA cores by Nvidia, but both perform the same task. Unlike a CPU, which is designed to handle a wide array of tasks, but only able to execute a handful of threads in parallel at a high clock speed, GPU cores are massively parallel and designed to handle specific tasks such as shader calculations. They can also be used for compute operations, but typically these features are heavily neutered in gaming cards, as the manufacturers want their most demanding clients paying top dollar for expensive workstation cards that offer full support for compute functionality. Since AMD and Nvidia's processor cores are built on different architectures, it's impossible to make direct comparisons between them, so just because one GPU has more cores than another does not automatically make it better.

MEMORY BUS

The memory bus is a crucial pathway between the GPU itself and the card's onboard frame buffer, or memory. The width of the bus and the speed of the memory itself combine to give you a set amount of bandwidth, which equals how much data can be transferred across the bus, usually measured in gigabytes per second. In this respect, and what generally stands with all things PC, more is better. As an example, a GTX 680 with its 6GHz memory (1,500MHz quad-pumped) and 256-bit interface is capable of transferring 192.2GB of data per second, whereas the GTX Titan with the same 6GHz memory but a wider 384-bit interface is capable of transferring 288.4GB per second. Since most modern gaming boards now use 6GHz memory, the width of the interface is the only spec that ever changes, and the wider the better. Lower-end cards like the HD 7790, for example, have a 128-bit memory bus, so as you spend more money you'll find cards with wider buses.

GPU BOOST

This technology is available in high-end GPUs, and it allows the GPU to dynamically overclock itself when under load for increased performance. GPUs without this technology are locked at one core clock speed all the time.

FRAME BUFFER

The frame buffer is composed of DDR memory and is where all the computations are performed to the images before they are output to your display, so you'll need a bigger buffer to run higher resolutions, as the two are directly related to one another. Put simply, if you want to run higher resolutions—as in fill your screen with more pixels—you will need a frame buffer large enough to accommodate all those pixels. The same principle applies if you are running a standard resolution such as 1080p but want to enable super-sampling AA (see sidebar on the right): Since the scene is actually being rendered at a higher resolution and then down-sampled, you'll need a larger frame buffer to handle that higher internal resolution. In general, a 1GB or 2GB buffer is fine for 1080p, but you will need 2GB or 3GB for 2560x1600 at decent frame rates. This is why the GTX Titan has 6GB of memory, as it's designed to run at the absolute highest resolutions possible, including across three displays at once. Most midrange cards now have 2GB, with 3GB and 4GB frame buffers now commonplace for high-end GPUs.

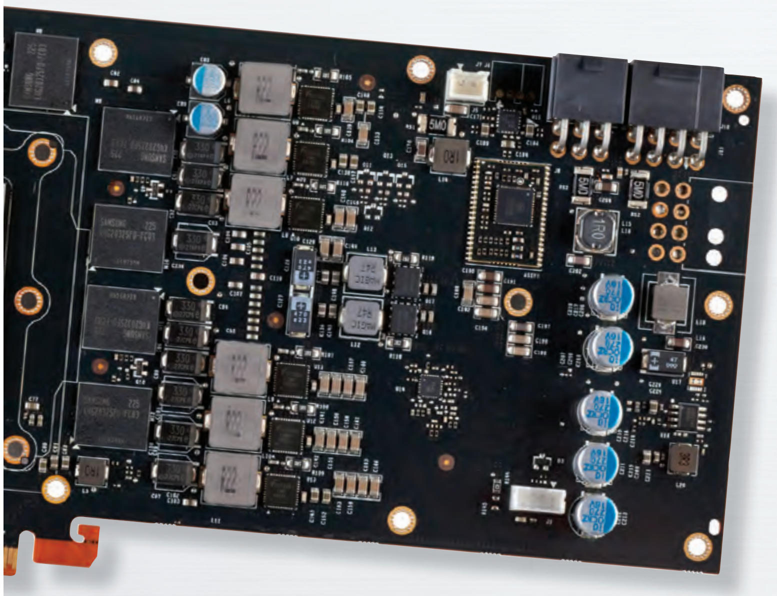
POWER REQUIREMENTS

All modern GPUs use PCI Express power connectors, either of the 6-pin or 8-pin variety. Small cards require one 6-pin connector, bigger cards require two 6-pin, and the top-shelf cards require one 8-pin and one 6-pin. Flagship boards like the GTX 690 and HD 7990 need two 8-pin connectors. Most high-end cards will draw between 100–200W of power under load, so you'll need around a 500–650W PSU for your entire system. Always give yourself somewhat of a buffer, so when a manufacturer says a 550W PSU is required, go for 650W.

DISPLAY CONNECTORS

These are what connect your GPU to your display, the most common being DVI, which comes in both single-link and dual-link. Dual-link

High resolutions require a lot of RAM, which is embedded in the area around the GPU just like on this 6GB GTX Titan.



is needed for resolutions up to 2560x1600, while single-link is fine for up to 1,200 pixels vertically. DisplayPort can go up to 2560x1600, as well. HDMI is another connector you will see: versions 1.0–1.2 support 1080p, 1.3 supports 2560x1600, while 1.4 supports 4K.

PCI EXPRESS 3.0

The latest generation of graphics cards from AMD and Nvidia are all PCIe 3.0, which theoretically allows for more bandwidth across the bus compared to PCIe 2.0, but actual in-game improvement will be slim-to-none in most cases, as PCIe 2.0 was never saturated to begin with. Your motherboard chipset and CPU must also support PCIe 3.0, but most Ivy Bridge and older boards do not support it in the chipset, even though the CPU may have the required lanes. In general, every GPU has PCIe 3.0 these days, but if your motherboard only supports version 2.0 you will not suffer a performance hit.

COOLING

GPU coolers fall into several different categories, including blower, centralized, and water-cooled. The blower type is seen on most "reference" designs, which is what AMD and Nvidia provide to their add-in board partners as the most cost-effective solution typically. It sucks air in from the front of the chassis, then blows it along a heatsink through the back of the card to be exited out the rear of your case. Centralized coolers have one or two fans in the middle that suck air in from anywhere around the card and exhaust it into the same region, creating a pocket of warm air below the card. Water-cooled cards are very rare, of course, but use water to absorb heat contained within a radiator, which is cooled by a fan. Water cooling is usually the most effective (and quiet) way to cool a hot PC component, but its cost and complexity make it less common.

PHYSX

This is Nvidia technology baked into its last few generations of GPUs that allows for hardware-based rendering of physics in games that support it, most notably Borderlands 2, so instead of just a regular explosion, you will see an explosion with particles and volumetric fog and smoke. Typically, AMD card owners will see the PhysX option grayed out in the menus, but the games still look great, so we would not deem this technology a reason to go with Nvidia over AMD at this point in time.

Antialiasing Explained

Different GPUs offer different types of antialiasing (AA), which is the smoothing out of jaggies that appear on edges of surfaces in games. Let's look at the most common types:

Full Scene AA (FSAA, or AA): The most basic type of AA, this is sometimes called super-sampling. It involves rendering a scene at higher resolutions and then down-sampling the final image for a smoother transition between pixels, which appears like softer edges on your screen. If you run 2X AA, the scene will be calculated at double the resolution, and 4X AA renders it at four times the resolution, hence a massive performance hit.

Multi-Sample AA (MSAA): This is a more efficient form of FSAA, even though scenes are still rendered at higher resolutions, then down-sampled. It achieves this efficiency by only super-sampling pixels that are along edges; by sampling fewer pixels, you don't see as much of a hit as with FSAA.

Fast Approximate AA (FXAA): This is a shader-based Nvidia creation designed to allow for decent AA with very little to no performance hit. It achieves this by smoothing every pixel onscreen, including those born from pixel shaders, which isn't possible with MSAA.

TXAA: This is specific to Kepler GPUs and combines MSAA with post-processing to achieve higher-quality antialiasing, but it's not as efficient as FXAA.

Morphological Antialiasing (MLAA): This is AMD technology that uses GPU-accelerated compute functionality to apply AA as a post-processing effect as opposed to the super-sampling method.

Wi-Fi Router

Though the basic functionality of Wi-Fi routers has remained relatively unchanged since the olden days, new features have been added that help boost performance and allow for easier management

BAND

The band that a router operates on is key to determining how much traffic you will have to compete with. You would never want to hop on a congested freeway every day, and the same logic applies here. Currently there are two bands in use: 2.4GHz and 5GHz. Everyone and their nana is on 2.4GHz, including people nuking pizzas in the microwave, helicopter parents monitoring their baby via remote radios, and all the people surfing the Internet in your vicinity, making it a crowded band, to say the least. However, within the 2.4GHz band you still have 11 channels to choose from, which is how everyone is able to surf this band without issues (for the most part). But if everyone is using the same channel, you will see your bandwidth decrease. On the other hand, 5GHz is a no-man's-land at this time, so routers that can operate on it cost a pretty penny since it's the equivalent of using the diamond lane, and a great way to make sure your bandwidth remains unmolested.

MIMO

This stands for multiple-input, multiple-output and it's the use of multiple transmitters and receivers to send/receive a Wi-Fi signal in order to improve performance, sort of like RAID for storage devices but with Wi-Fi. These devices are able to split a signal into several pieces and send it via multiple radio channels at once. This improves performance in a couple of ways. When only one signal is being sent, it has to bounce around before ending up at the receiver, and performance is degraded. When several signals are sent at the same time, however, spectral efficiency is improved as there is a greater chance of one hitting the receiver with minimal interference; it also improves performance with multiple streams of data being carried to the receiver at once.

CHANNEL BONDING

Channel bonding is something that's done by the router and the network adapter whereby parallel channels of data are "bonded" together much like stripes of data in a RAID. This technology is most prevalent in 802.11n networks, where channel bonding is required for a user to utilize the full amount of bandwidth available in the specification. The downside to channel bonding is that it increases the risk of interference from nearby networks, which can reduce speeds. Since each channel is 20MHz, "bonded mode" operates at 40MHz, so check your settings to see if you can enable this.

802.11 STANDARDS

Every router adheres to a specific 802.11 standard, which governs its overall performance and features. In the old days, there was 802.11a/b, then 802.11g, then 802.11n, which is the most widespread specification in use today since it's been around for a few years and is relatively fast. Waiting in the wings is 802.11ac, which by default broadcasts on the uncongested 5GHz band, but is also backward compatible with 2.4GHz. Whereas 802.11g had a peak throughput of 300Mb/s, 802.11n has a peak of roughly 500Mb/s, and 802.11ac doubles that to an unholy 1.3Gb/s. It achieves this speed increase by supporting up to eight channels compared to 802.11n's four, and through increased channel width, using 80MHz and an optional 160MHz channel.

QUALITY OF SERVICE (QOS)

QoS is a common feature on today's routers, and it lets you dictate which programs get priority when it comes to network bandwidth. You could theoretically slow down uTorrent while giving Netflix and Skype or Battlefield 3 more bandwidth. One crucial point is that the QoS setting is most important for *outgoing* traffic such as torrents, since incoming traffic is usually already prioritized by your ISP.



High-end 802.11n routers are able to broadcast dual networks on both 2.4GHz and 5GHz bands, though the new 802.11ac standard uses the 5GHz band by default.

RAM

System RAM, or memory, seems like such a basic thing, but there's still much to know about it

CLOCK SPEED

The clock speed of RAM is usually expressed in megahertz, so DDR3/1866 runs at 1,866MHz, at a certain latency timing. The only problem is that modern CPUs pack so much cache and are so intelligent in managing data that very high-clocked RAM rarely impacts overall performance. Going from, say, DDR3/1600 to DDR3/1866 isn't going to net you very much at all. Only certain bandwidth-intensive applications such as video encoding can benefit from higher-clocked RAM. The sweet spot for most users is 1,600 or 1,866. The exception to this is with integrated graphics. If the box will be running integrated graphics, reach for the highest-clocked RAM the board will support and you will see a direct benefit in most games.

CHANNELS

Modern CPUs support everything from single-channel to quad-channel RAM. There isn't really a difference between a dual-channel kit and a quad-channel kit except that the vendor has done the work to match them up. You can run, for example, two dual-channel kits just fine. The only time you may want a factory-matched kit is if you are running the maximum amount of RAM or at a very high clock speed.

VOLTAGE

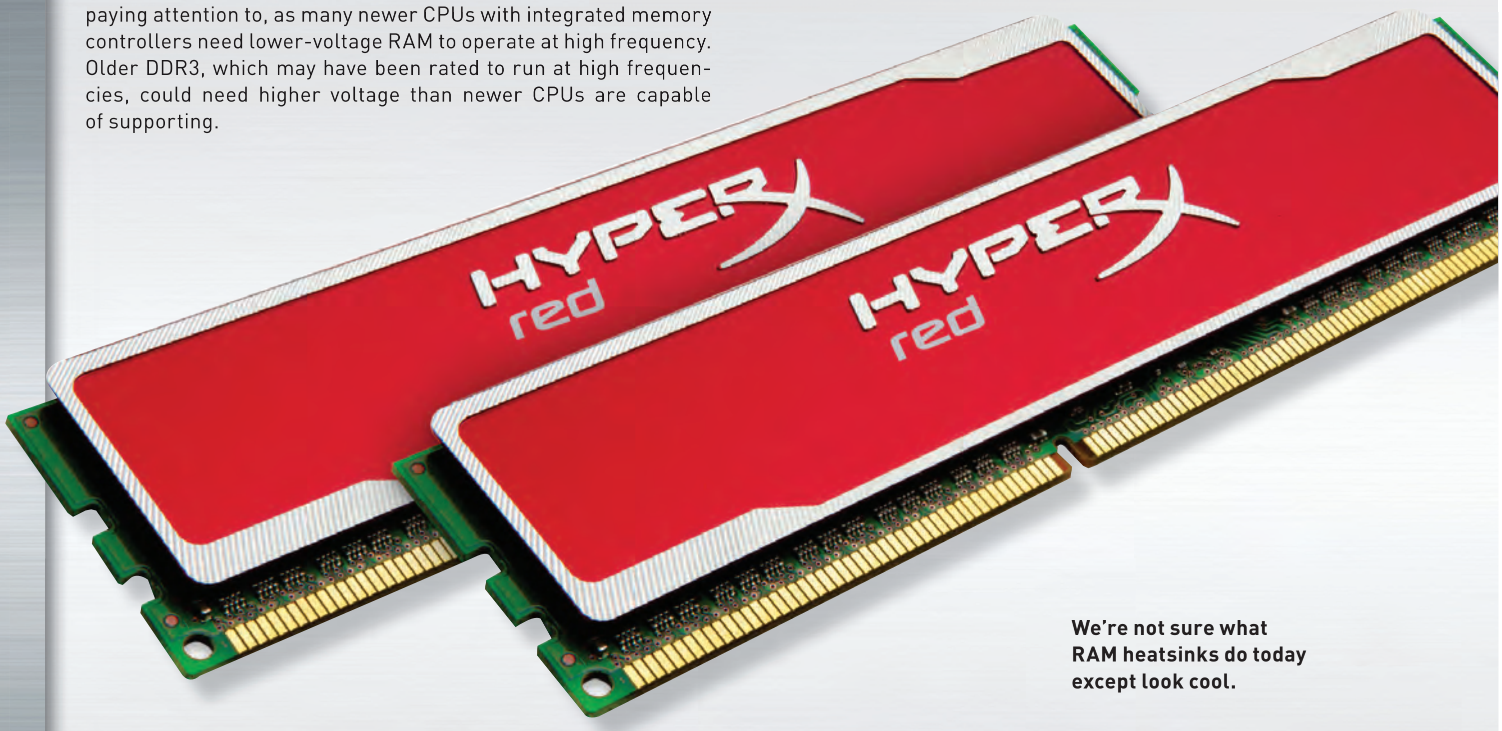
Voltage isn't a prominent marketing spec for RAM but it's worth paying attention to, as many newer CPUs with integrated memory controllers need lower-voltage RAM to operate at high frequency. Older DDR3, which may have been rated to run at high frequencies, could need higher voltage than newer CPUs are capable of supporting.

HEATSPREADERS

Heat is bad for RAM, but we've never been able to get any vendor to tell us at what temperature failures are induced. Unless you're into extreme overclocking, if you have good airflow in your case, you're generally good. We've come to feel that heatspeaders, for the most part, are like hubcaps. They may not do much, but who the hell wants to drive a car with all four hubcaps missing?

CAPACITY, REGISTERED DIMMS, AND ERROR CORRECTION

It's pretty easy to understand capacity on RAM—16GB is more than 8GB and 4GB is more than 2GB. With unbuffered, nonregistered RAM, the highest capacity you can get to run with a consumer CPU are 8GB modules. Registered DIMMs, or buffered DIMMs, usually refers to extra chips, or "buffers," on the module to help take some of the electrical load off the memory controller. It's useful when running servers or workstations that pack in a buttload of RAM. ECC RAM refers to error-correcting control and adds an additional RAM chip to correct multi-bit errors that can't be tolerated in certain high-precision workloads. If this sounds like something you want, make sure your CPU supports it. Intel usually disables ECC on its consumer CPUs, even those based on the commercial ones. AMD, on the other hand, doesn't. For most, ECC support is a bit overkill, though.



We're not sure what RAM heatsinks do today except look cool.

Power Supply Unit

The power supply doesn't get all the attention of, say, the CPU or the video card, but disrespect the PSU at your own peril

WATTAGE

The actual wattage of the PSU is the spec everyone pays attention to. That's because 650 watts is 650 watts, right? Well, not always. One maker's 650 watts might actually be more like 580 watts or lower at the actual temperature inside your case on a hot day. Despite all this, the wattage rating is still one of the more reliable specs you can use to judge a PSU. How much you need can only be answered by the rig you're running. We will say that recent GPU improvements have caused us to back away from our must-have-1,000W-PSU mantra. These days, believe it or not, a hefty system can run on 750 watts or lower with a good-quality PSU.

EFFICIENCY

After wattage, efficiency is the next checkmark feature. PSU efficiency is basically how well the unit converts the power from AC to DC. The lower the efficiency, the more power is wasted. The lowest efficiency rating is 80 Plus, which means 80 percent of the power at a load of 20 percent, 50 percent, or 100 percent is converted. From there it goes to Bronze, Silver, Gold, and Platinum, with the higher ratings indicating higher efficiency. Higher is better, but you do get diminishing returns on your investment as you approach the higher tiers. An 80 Plus Silver PSU hits 88 percent efficiency with a 50 percent load. An 80 Plus Platinum hits 92 percent. (Efficiencies for the higher tiers vary at different loads.) Is it worth paying 40 percent more for that? That's up to you.

SINGLE-RAIL VS. MULTI-RAIL

A single-rail PSU spits out all the power from a single "rail," so all of the 12 volt power is combined into one source. A multi-rail splits it into different rails. Which is better? On a modern PSU, it doesn't matter much. Much of the problems from multi-rail PSUs were in the early days of SLI and Pentium 4 processors. PSU designs that favored CPUs, combined with the siloing of power among rails, proved incapable of properly feeding a multi-GPU setup. Single-rail designs had no such issues. These days, multi-rail PSUs are designed with today's configs in mind, so multi-GPUs are no longer a problem.

INTELLIGENT VS. DUMB

A "dumb" power supply is actually what 99 percent of us have: a PSU that supplies clean, reliable power. An "intelligent" PSU does the same but communicates telemetry to the OS via USB. Some smart PSUs even let you adjust the voltages on the rails in the operating system (something you'd have to do manually on high-end units) and let you control the fan temperature intelligently, too. Do you need a smart PSU? To be frank, no. But for those who like seeing how efficient the PSU is or what the 5-volt rail is, it's pretty damned cool.

MODULAR VS. NON-MODULAR

Modular PSUs are the rage and give you great flexibility by letting you swap in shorter cables, or cables of a different color, or to remove unused cables. The downside is that most high-end machines use all of the cables, so that last point in particular is moot—what's more, we think it's too easy to lose modular cables, which sucks.



Modular power supplies are the rage today—just don't misplace the cables.

System Specs

HOW TO DOLE OUT SYSTEM ADVICE LIKE A PRO

Warning: As a PC expert, you will be called upon often by family and friends for system-buying advice. After all, purchasing a new PC retail can be a daunting task for the average consumer. Remember, you might know the difference between an AMD FX-8350 and FX-6100, but will Aunt Peg?

No, Aunt Peg will walk into the local Big Box with the goal of spending $750 on a basic all-in-one and end up walking out with a $3,000 SLI rig. We're not saying that Aunt Peg doesn't like getting her frag on as much as the rest of us, but let's face it, she needs some basic buying tips.

CPU

Peg, what level of CPU you require depends on your needs. If your idea of a good time is Bejeweled, email, and basic photo editing, a dual-core processor of any model except Atom is more than enough. If you're looking for more performance, the good thing is that Intel and AMD's model numbers can mostly be trusted to represent actual performance. A Core i5 is greater than a Core i3 and an A10 is faster than an A8. If you are doing home video editing, Peg, consider paying for a quad-core CPU or more.

RAM

There are three known levers pulled when convincing consumers to buy a new PC: CPU, storage size, and amount of RAM. You'll often see systems with low-end processors loaded up with a ton of RAM, because someone with a Pentium is really in the market for a system with 16GB of RAM (not!). For most people on a budget, 4GB is adequate, with 8GB being the sweet spot today. If you have a choice between a Pentium with 16GB and a Core i3 with 8GB, get the Core i3 box.

STORAGE

Storage is pretty obvious to everyone now, and analogous to closet space. You can never have enough. What consumers should really look for is SSD caching support or even pony up for an SSD. SSD caching or an SSD so greatly improves the feel of a PC that only those on a very strict budget should pass on this option. SSDs are probably one of the most significant advances to PCs in the last four years, so not having one is almost like not having a CPU. How large of an SSD do you need? The minimum these days for a primary drive is 120GB, with 240GB being more usable.



GPU

There's a sad statistic in the PC industry: Americans don't pay for discrete graphics. It's sad because a good GPU should be among the top four specs a person looks at in a new computer. Integrated graphics, usually really bad Intel integrated graphics, have long been a staple of American PCs. To be fair, that's actually changing, as Intel's new Haswell graphics greatly improves over previous generations, and for a casual gamer, it may even finally be enough. Still, almost any discrete GPU is still faster than integrated graphics these days. Aunt Peg might not play games, but her kids or grandkids might and not having a GPU will give them a frowny face. A GeForce 650 or Radeon HD 7770 is a good baseline for any machine that will touch games.



This machine is probably too much PC for Aunt Peg to handle.

HERE COMES HASWELL

CAN A LAPTOP CPU KEEP ENTHUSIASTS HAPPY?

By Gordon Mah Ung

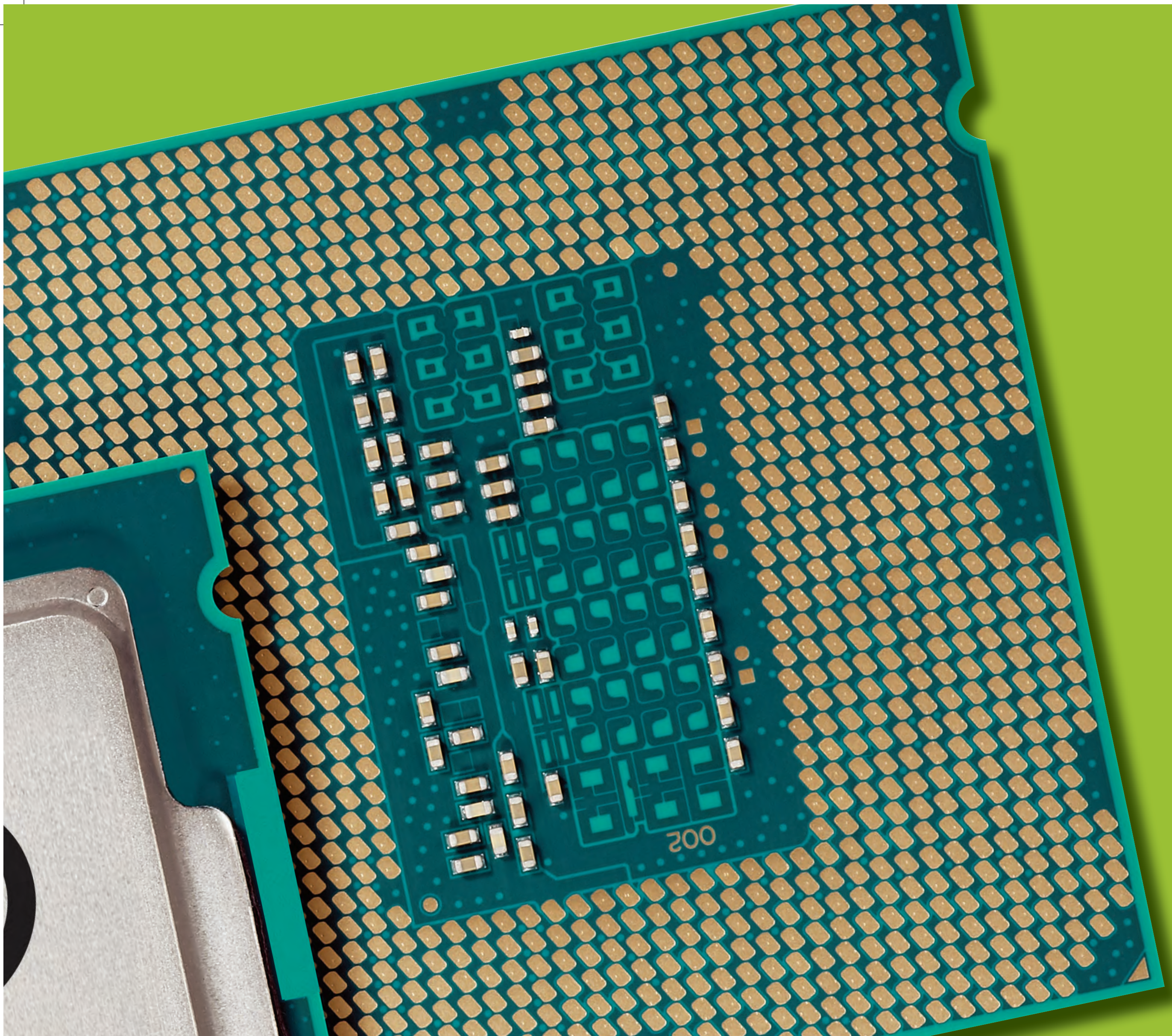


FASTER HARDWARE shouldn't be this somber. Yet we can't help but furrow our brow in concern over Intel's fourth-generation Core i7 CPU. Yes, in typical Intel fashion, it's a tour de force of technical achievement and features that's the envy of the free world. It's also, by the way, quite fast.

How fast? *Spoiler alert* Let's just say that the new Core i7-4770K easily unseats the previous midrange sweetheart, the Core i7-3770K, as the best all-around performer, and even gives the high-end hexa-core part a hard time.

So, why are we so sad? Maybe it's the continual whispers of the PC's impending doom—that despite the pure joy a powerful PC can bring the world, its days are numbered.

Or maybe it's because it's clear that, while Haswell is fast, it's a part that is obviously designed primarily to benefit laptops, tablets, and other small-computing needs rather than desktops. Let's just say, as happy as we are about where Haswell lands in performance, we're still concerned about Intel's commitment to performance desktop computing, and that doesn't make us feel good.



THE HASWELL LINEUP

	Core i7-4770T	Core i7-4770S	Core i7-4770	Core i7-4770K	Core i7-4770R	Core i5-4670K	Core i5-4670	Core i5-4570
Bulk Price	$303	$303	$303	$339	N/A	$242	$213	$192
TDP	45W	65W	84W	84W	65W	84W	84W	84W
Cores/Threads	4/8	4/8	4/8	4/8	4/8	4/4	4/4	4/4
CPU Base Freq	2.5GHz	3.1GHz	3.4GHz	3.5GHz	3.2GHz	3.4GHz	3.4GHz	3.2GHz
Max Turbo Freq	3.7GHz	3.9GHz	3.9GHz	3.9GHz	3.9GHz	3.8GHz	3.8GHz	3.6GHz
DDR3 (MHz)	1,333/1,600	1,333/1,600	1,333/1,600	1,333/1,600	1,333/1,600	1,333/1,600	1,333/1,600	1,333/1,600
L3 Cache	8MB	8MB	8MB	8MB	6MB	6MB	6MB	6MB
L4 Cache	N/A	N/A	N/A	N/A	128MB	N/A	N/A	N/A
Graphics	4600	4600	4600	4600	5200	4600	4600	4600
Graphics Max Frequency (MHz)	Up to 1,200	Up to 1,200	Up to 1,200	Up to 1,250	Up to 1,300	Up to 1,200	Up to 1,200	Up to 1,150
Package	LGA1150	LGA1150	LGA1150	LGA1150	BGA	LGA1150	LGA1150	LGA1150



One new Haswell includes the south bridge inside the package.

HASWELL'S MIXED BAG

A new platform is just one of the features that might irk enthusiasts

The most noticeable change for any enthusiast is the introduction of a new socket. LGA1155 has carried us from Sandy Bridge through Ivy Bridge, but as Intel doesn't like you to ever get too comfortable with a motherboard, it's shedding that old LGA1155 for a new LGA1150 socket. The two are, of course, incompatible. Why? It's not just to piss you off, but more likely due to the fact that Intel can't integrate the new Haswell features in LGA1155. The new socket should come as no surprise to anyone who reads *Maximum PC*, as we've been reporting on Intel's plan for Haswell for a while, but here it is officially: If you want the new CPU, you need a new motherboard. AMD /AM3+ fanboys can feel free to unleash a big Nelson Muntz–style "ha-ha!" in the faces of Intel fanboys.

GOT A SPARE FIVR, BUDDY?

We've long said that Intel's CPUs are gravitational black holes sucking everything into them. Nehalem ate the memory controller. Lynnfield swallowed PCIe. Sandy Bridge gobbled up graphics. And Haswell has a new fully integrated voltage regulator, or FIVR, inside the package. By integrating the voltage regulator, Intel simplifies power inputs into the CPU but also takes a lot of the control out of the motherboard makers' hands. The FIVR doesn't eliminate *all* voltage regulation on the motherboard, as the power to the CPU must still come from somewhere, so you'll still find boards with beefy caps and voltage regulation circuits.

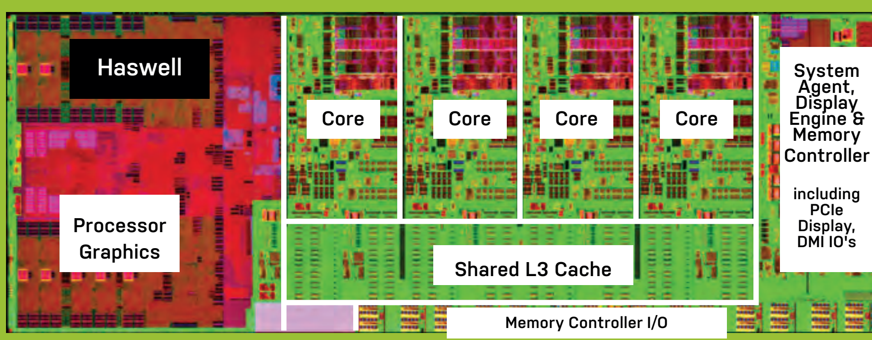
By integrating the VR, though, Intel is able to regulate power to a much finer degree than has been possible on even the best motherboards. Voltage ripple is practically nil on the design, and the performance of the FIVR outstrips anything that can be done externally. The FIVR also technically lowers the cost of a motherboard, as some of the external voltage regulators are no longer needed.

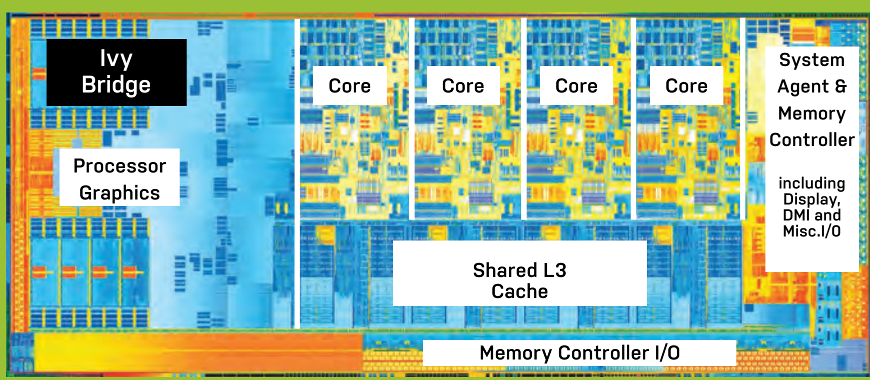
The FIVR isn't a free ride, though. It adds more heat to the CPU and raises the TDP of the 4770K to 84 watts compared to the 77 watts of its predecessor.

The bigger question for desktops users is, why? The hard truth is that we suspect the change was not done to benefit desktop PCs. It's to benefit laptops, all-in-ones, and anything else that really needs precise control over power and voltage in a very thin package. In other words,

HASWELL VS. IVY BRIDGE IN PICTURES

THE MOVE FROM Sandy Bridge to Ivy Bridge saw graphics die space eat up a lot more area. On casual examination, Haswell looks almost the same proportionally as Ivy Bridge, but does have an additional 200,000 transistors tucked inside. The onboard fully integrated voltage regulator isn't actually on the die but is inside the package. Intel chips with the 128MB of embedded DRAM will also show an additional strip of silicon inside the package but outside the actual die area.





it's a move that's all about mobile and small computing. The good news is that it doesn't seem to hurt enthusiasts very much. Yes, you'll need beefy cooling to run Haswell overclocked, but you always needed that.

OVERCLOCKING GIVE AND TAKE

When Intel jumped from Lynnfield to Sandy Bridge chips, it left behind the ability to pump up the base clock to overclock a chip. Overclockers still got unlocked "K" CPUs, but even non-K parts could overclock by four bins through the multiplier on Z-series boards. With Haswell, that feature is now gone, so non-K parts are truly clock-blocked in every way possible.

The good news for enthusiasts is that Intel has added more knobs to K-chip overclocking. Borrowing from the Sandy Bridge-E chips, Haswell K chips will now offer additional CPU straps for overclocking. Rather than being limited to just 100MHz and a few megahertz above it, additional ratios of 125MHz, 160MHz, and 250MHz should be available to help overclock the CPU without overclocking PCIe and other clock-sensitive components.

BIG FAT L4—JUST NOT FOR YOU

One of the most exciting developments in the Haswell parts list is the new Core i7-4770R. This one chip features a massive 128MB of embedded DRAM, or eDRAM, to ameliorate memory bandwidth issues in graphics. Don't care about integrated graphics? You should, because the R part's eDRAM also acts as a massive L4 cache, which, according to some developers, offers a pretty big boost in performance outside of graphics. The really bad news is that you can't get it in anything other than a BGA chip today. After hearing the objections of the enthusiast tech press (see, we help you sometimes), Intel is looking at the option of offering a socketed R chip.

TSX FOR ONLY SOME OF US

Much has been said about Intel's transactional memory feature, or TSX, in Haswell. TSX essentially makes it easier for programmers to write multithreaded code by addressing the complexities of having to lock portions of an array of data. TSX lets the processor handle much of the grunt work. Now for the bad news: TSX is apparently only available on some Haswell chips. Intel souldn't say which chips had it and which didn't, but a leaked chart on Tom's Hardware indicates that the only two chips we care about—the two unlocked K parts—don't have it.

AND THE GOOD NEWS?

So, Haswell runs a bit hotter, takes some voltage control out of your hands, eliminates the non-K overclocks, doesn't give enthusiasts access to the large L4 cache version, doesn't have TSX in the K parts, and, well, requires a new motherboard, too. You're probably wondering just where the hell the good news is for enthusiasts with Haswell.

Despite all our bitching, we will say that Intel has at least paid attention to the one metric that counts most: performance. Intel didn't just take an Ivy Bridge die, erase the name, and pencil in Haswell. The company has added new instructions to Haswell, including AVX2 and FMA2, that will eventually benefit you. The company has also increased the execution ports and generally made a lot of nips and tucks in the name of performance. What this means is that, clock for clock, Haswell offers a noticeable performance boost over Ivy Bridge. The full skinny on Haswell's performance follows, but let's just say it again: It's fast. The apparent lack of TSX, fat L4, and multiplier overclocking might give you a frowny face, but maybe the only people who should really have a frowny face are those who just bought into a full-boat LGA1155 system with a top-of-the-line Core i7-3770K chip.

8-SERIES ERASES PREVIOUS MISTAKES

WE'VE BITCHED about Intel not giving us this or not giving us that, but the company has at least finally fixed our biggest complaint since, well, forever. Intel's P67 first introduced native SATA 6Gb/s that made third-party drive controllers seem horrible by comparison. The only problem? SATA 6Gb/s was only supported on two ports. Back in 2011, this wasn't an issue, as who the hell had more than two SSDs that could even push a SATA 6Gb/s interface? Today, with SSD prices truly affordable and capable of saturating SATA 6Gb/s ports, it's a problem. Oh, that and AMD has had native 6Gb/s across all six SATA ports since 2010 (cue Nelson Muntz again).

The new Z87 chipset corrects that. All six ports are SATA 6Gb/s. Intel has also upped the USB support, going from four USB 3.0 ports to six ports, and from 10 USB 2.0 ports to 14 USB 2.0 ports. The Z87 chipset now also supports per-port disabling for security purposes.

There was news earlier this year that the USB 3.0 support in the Z87 chipset was botched. The apparent bug would put USB 3.0 devices into sleep modes. We've queried board makers and OEMs who believe that the issue is mostly resolved now, and only existed in earlier revisions of silicon, which shouldn't reach consumers' hands.

Other than the elimination of support for PCI, the Z87 chipset doesn't look too different from its predecessor.

Z87 finally gives us SATA 6Gb/s across all ports!



HASWELL GRAPHICS FINALLY GOOD ENOUGH?

We're going to kick that football to the moon

Intel's x86 prowess has almost always been the envy of the free world. We can say that without anyone except the most ardent AMD fanboy objecting, because when it comes to x86 performance, Intel has thoroughly cleaned everyone's clocks. From PowerPC to 68000K and from SPARC to MIPs, Intel's x86 parts have sent everyone packing.

When it comes to graphics, though, most agree it's been the exact opposite. Old salts will remember Intel's disastrous entrance into discrete graphics with the i740 in late 1990. Despite analyst predictions of an Intel-led graphic-card-ageddon, Intel instead withdrew with its video card between its legs two years later. Though a sucktacular non-success, Intel turned lemons into gold-plated lemonade when it embedded i740 into the 810 chipset. Believe it or not, today, Intel's integrated graphics dominate in market penetration over AMD and Nvidia graphics chips.

But Intel wants more than to merely excel at sucky graphics, and has been on a steady march to gain some respect. Every year, Intel proclaims its integrated graphics much improved, and usually people shrug it off as Lucy trolling that sap Charlie Brown. With Ivy Bridge, though, Intel's graphics indeed got better, but overall still couldn't compete with even low-end discrete parts. This time, Lucy says, it's different. But is it? Are Haswell graphics really, finally good enough to replace discrete graphics? We can't say—yet.

First, to be fair to Intel graphics, our ability to judge its performance is only based on the HD4600 part embedded in the Core i7-4770K chip—a CPU no one is likely to use without a discrete GPU. The HD 5000 and HD 5200 are actually the "real deal," but we couldn't get our mitts on them. HD4600 is indeed better than Ivy Bridge, though. To compare, we used the same rigs we used for the other benchmarks in this story, but ripped out the discrete cards. We saw Haswell offering a healthy increase over Ivy Bridge. In fact, in Portal 2, which we considered unplayable with Ivy Bridge at 1080p resolutions, Haswell gave us reasonable (but not fantastic) frame rates with image quality turned down a few notches. Not bad, honestly. Resident Evil 6 at 1360x768 saw Haswell with twice the performance of Ivy Bridge. Other games also gave Haswell a good leg up over its predecessor. Enough to replace discrete graphics? Hell no. At least, not with HD4600.

One final wrinkle came from AMD. The company tossed us its new "Richland" A10-6800K APU that features an integrated Radeon HD 8670D graphics part. With the same amount of RAM and clocked at the same DDR3/1600, this budget APU actually drubs the far pricier Core i7-4770K in just about every test we threw at it (which is why AMD was probably quick to get it in our hands). That's not bad for an APU that'll probably sell for $140. Yes, it'll get schooled six ways to Sunday in any x86 chores, but it's a cheap chip, too.

The Bantha in the room is really Intel's HD5200 graphics. With its 128MB of eDRAM, we suspect that it'll give even AMD's best APUs a sound thrashing and might finally be the football Charlie Brown has been waiting to kick all these years.

HASWELL VS. IVY BRIDGE GRAPHICS

	Core i7-4770K	Core i7-3770K	A10-6800K
GPU	HD4600	HD4000	Radeon HD 8670D
3DMark Cloud Gate Overall	**7,373**	6,066	5,765
3DMark Cloud Gate Graphics	**7,264**	5,830	7,306
3DMark Fire Strike Overall	875	651	**981**
3DMark Fire Strike Graphics	947	698	**1,047**
3DMark Ice Storm Overall	54,182	51,001	**58,599**
3DMark Ice Storm Graphics	55,023	51,450	**67,909**
3DMark 11 Performance Overall	P1,413	P805	**P1,543**
3DMark 11 Performance Graphics	1,205	685	**1,414**
3DMark 11 Extreme Overall	X400	X256	**X458**
3DMark 11 Extreme Graphics	353	226	**412**
Resident Evil 6	2,098	1,098	**2,970**
Hitman: Absolution (fps)	33.3	26.1	**36.1**
Dirt 3: 13x7 (fps)	**65.2**	52.4	62.3
Dirt 3: 19x10 (fps)	43.1	35.3	**44.3**
CyberLink MediaEspresso 6.7	311	309	**374**
SiSoft Sandra GPGPU benchmark	185	138	**237**

Best scores are bolded.

HASWELL MEETS THE BENCHMARKS

A mobile-friendly design doesn't diminish desktop performance

Picking which CPUs to test was fairly straightforward: We went with the top-end Core i7-4770K, a Core i7-3770K, and to give people a perspective on how LGA2011 chips compare, a Core i7-3820. Even though it's out of the price band of the three others, we also decided to test the hexa-core Core i7-3930K to show the quad-core boys what they're missing, or not, by foregoing the two extra cores.

While differing sockets made it impossible to use identical motherboards for our tests, we at least stuck with one vendor in the hopes of achieving some uniformity. For LGA1155, we used an Asus P8Z77-V Premium, for LGA1366 an Asus Sabertooth X79, and Asus's new Z87-Deluxe board for the LGA1150. Each motherboard was outfitted with 16GB of Corsair DDR3 clocked at 1,600MHz. All three systems were outfitted with identical 240GB Corsair Neutron GTX SSDs, which had the same firmware and were Trimmed before testing began. For graphics, matching GeForce GTX 580 cards were used, with the same driver on each. For OS, we used Windows 8.

THE RESULTS

As previously mentioned, in performance, Haswell doesn't disappoint. For example, we ran Cinebench 10 across just one core to gauge the per-core performance. Haswell gave us about a 17 percent bump over Ivy Bridge. Against the older Sandy Bridge-E cores in the Core i7-3820, Haswell was about 30 percent faster.

In the other benchmarks, Haswell's advantage remained constant, with the new CPU performing faster than Ivy Bridge in just about every category, and the margins widening against the Sandy Bridge-E chip.

For the most part, Haswell offers an 8 to 15 percent performance boost over Ivy Bridge. In the heavily threaded Premiere Pro CS6 test, Haswell enjoyed a 12 percent advantage. The same 12 percent advantage also popped up in our ProShow Producer test, which tops out at about four threads.

In a search for more real-world results, we decided to throw HDRsoft's popular PhotoMatix at the CPU. We used a nine-shot RAW file from a Nikon D800 and ran a batch convert on it. From what we can tell, that particular load is heavily multithreaded and literally stops everything else while being run. Haswell pulled out a big win, processing the HDR about 22 percent faster than Ivy Bridge.

In the synthetic 3DMark gaming tests, both CPUs pulled even in the graphics test—no surprise. But in the physics test, Haswell again had a 10 percent gain over Ivy Bridge. In actual game engines, the difference between the two CPUs varied. We ran our tests at low quality and low resolutions to take the GPU out of the equation. In Dirt 3, we saw an astounding 34 percent difference between Haswell and Ivy Bridge, and in Total War: Shogun 2's CPU test, a 10 percent gain. We could go on, but for the most part, Haswell is across-the-board faster. Part of the performance improvements come from Intel's under-the-hood tweaks to the chip, but some of it also comes from the Turbo Boost modes. We monitored the chip's clock speed in some tests and found that sometimes it would run at 4.1GHz for long stretches of time, while the Ivy Bridge chip hung back at 3.8GHz. Com-

TOP PROCS COMPARED

	Intel Core i7-4770K	Intel Core i7-3770K	Intel Core i7-2700K	Intel Core i7-3820	Intel Core i7-3930K	Intel Core i7-3970X
Code-name	Haswell	Ivy Bridge	Sandy Bridge	Sandy Bridge-E	Sandy Bridge-E	Sandy Bridge-E
Clock	3.5GHz	3.5GHz	3.5GHz	3.6GHz	3.2GHz	3.5GHz
Turbo Clock (Max)	3.9GHz	3.9GHz	3.9GHz	3.9GHz	3.8GHz	4GHz
TDP	84W	77W	95W	130W	130W	150W
Cores/Threads	4/8	4/8	4/8	4/8	6/12	6/12
Volume Pricing	$339	$332	$342	$285	$594	$999
Graphics Core	HD4600	HD4000	HD3000	N/A	N /A	N/A
Process	22nm	22nm	32nm	32nm	32nm	32nm
Total L2 Cache	1MB	1MB	1MB	1MB	1.5MB	1.5MB
Total L3 Cache	8MB	8MB	8MB	10MB	12MB	15MB
Die Size	177mm^2	160mm^2	216mm^2	293mm^2	435mm^2	435mm^2
Transistor Count	1.6 billion	1.4 billion	995 million	1.27 billion	2.27 billion	2.27 billion
Socket	LGA1150	LGA1155	LGA1155	LGA2011	LGA22011	LGA22011
Memory Controller	Dual-channel DDR3/1600	Dual-channel DDR3/1600	Dual-channel DDR3/1333	Quad-channel DDR3/1600	Quad-channel DDR3/1600	Quad-channel DDR3/1600
DDR Frequency Overrides	DDR3/3000+	DDR3/2667	DDR3/2133	DDR3/2400	DDR3/2400	DDR3/2400

bining both the higher Turbo Boost speeds and the efficiency enhancements explains most of its wins against Ivy Bridge.

Haswell already has a leg up over Ivy Bridge, but up against the even older Sandy Bridge-E cores, it's a bit of a slaughter. If you were to peg the advantage Haswell has over Sandy Bridge-E, we'd say it's about 20 percent overall when its four cores versus four cores. The only advantage Sandy Bridge-E picks up is when you get to six cores. The Core i7-3930K has an advantage in heavily multithreaded tasks such as 3D rendering and video encoding. In gaming and apps that really can't exploit all six cores of the Core i7-3930K, Haswell comes out on top.

WHAT SHOULD YOU BUY?

First, Haswell doesn't invalidate Ivy Bridge systems. Machines built on Ivy Bridge are still quite fast and offer plenty of performance, but there's simply no reason to build on an older-generation CPU with a dead socket (good luck getting another LGA1155 out of Intel) with an inferior chipset. Sorry, but that's the truth, and we know some of you just built Ivy Bridge boxes, too, despite our warning you to wait a month or so.

When it comes to Haswell Core i7-4770K vs. Core i7-3820, it's a bit more tricky. Haswell flat-out leaves quad-core Sandy Bridge-E in the dust. The only reason to even build a Core i7-3820 box at this point is with an eye toward future upgrades. Intel is expected to push out Ivy Bridge-E or Ivy Town CPUs later this year.

That's pretty much our guidance for Core i7-3930K, too. The chip is almost twice as expensive as Core i7-4770K but if you work for a living pushing pixels in a 3D renderer, or video encoder, it's worth it. If you can cut a four-hour video encode down to three hours with Core i7-3930K, you can work on other projects that pay, rather than wait. The only caveat is that Haswell's higher clock and improved core can actually be as fast, even on multithreaded workloads. Peep our PhotoMatix test that saw the Core i7-4770K actually beat the six-core Core i7-3930K.

Despite all our negativity, we have to say, Haswell can still make us smile. We can't help but wonder, though, as impressive as Haswell is in performance, what it could have been like if Intel had focused on making Haswell a purely desktop-enthusiast part. We fear those days are behind us, though.

BENCHMARKS

	3.5GHz Core i7-4770K	3.5GHz Core i7-3770K	3.6GHz Core i7-3820	3.2GHz Core i7-3930K
PCMark 7 Score	**6,348**	5,902	5,607	5,606
PCMark 7 Lightweight	**6,741**	6,260	6,258	6,161
PCMark 7 Productivity	**6,274**	5,804	5,524	5,457
PCMark 7 Computation	**9,454**	9,179	8,834	8,797
Cinebench 10 Single Core	**8,240**	7,037	6,275	6,259
Cinebench 10 Multi-Core	31,581	27,743	24,816	**34,533**
Cinebench 11.5	8.88	7.95	7.38	**10.9**
POV Ray 3.7 RC7 (sec)	157.1	182.4	198.5	**134.7**
Fritz Chess Benchmark (Kilonodes/s)	**15,514**	14,631	14,191	14,160
Stitch.Efx 2.0 (sec)	**772**	868	959	872
PhotoMatix HDR (sec)	**184**	224	260	192
Premiere Pro CS6 (sec)	2,522	2,830	2,996	**2,012**
ProShow Producer (sec)	**1,314**	1,469	1,531	1,461
TechARP X264 5.01 Pass 1 (fps)	84.8	76.2	71.03	**99.9**
TechARP X264 5.01 Pass 2 (fps)	17.5	15.3	13.95	**20.8**
HandBrake 0.9.9 (sec)	1,314	1,469	1,531	**866**
7-Zip 64MB load 12 threads (MIPS)	**3,076**	2,978	2,893	2,791
7-Zip 64MB load 8 threads (MIPS)	3,102	3,059	2,831	**3,359**
Sandra RAM bandwidth (GB/s)	20.3	20.1	38.2	**41**
Sandra L1 Cache (GB/s)	**1,001**	544	524	780
Valve Particle Test (fps)	226	209	198	**286**
3DMark 11 Score	X2,209	X2,189	X2,217	**X2,231**
3DMark 11 Graphics	1,976	1,964	**1,989**	**1,988**
3DMark 11 Physics	9,876	9,887	8,844	**11,984**
3DMark 11 Combined	2,668	2,617	2,672	**2,675**
3DMark Fire Strike Overall	4,618	4,540	4,549	**4,638**
3DMark Graphics	**5,045**	4,980	5,021	5,015
3DMark New Physics	11,598	10,514	9,802	**13,656**
Resident Evil 6	**13,644**	13,333	12,022	12,110
Dirt 3 (fps)	**243.2**	181	178	184.5
Hitman: Absolution (fps)	77.1	77.9	74.7	**79.2**
Total War: Shogun 2 (fps)	**41.3**	37.6	35.2	37.7

Best scores are bolded.

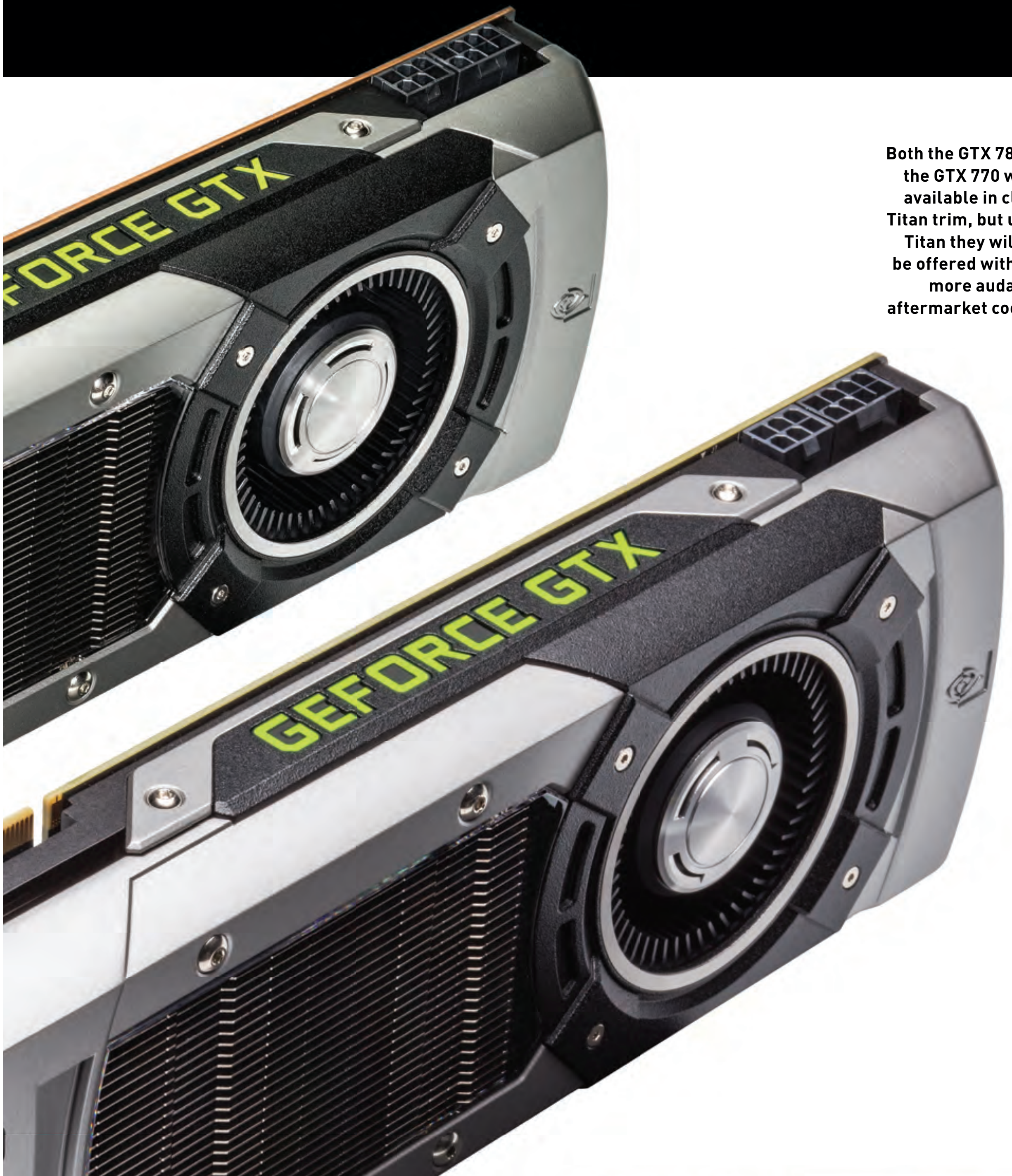
Kepler 2.0 Arrives

With the GTX 780 and GTX 770, Nvidia seeks to cement its role as king of the high-end GPU

BY JOSH NOREM



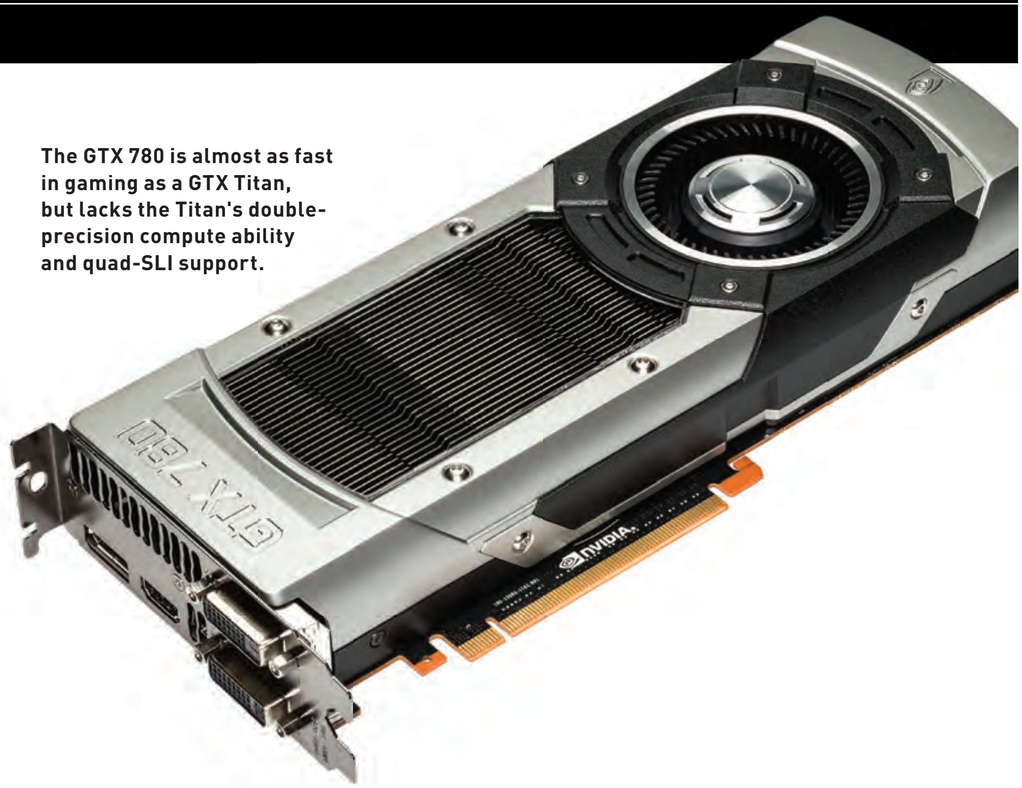
THIS MONTH, NVIDIA has finally unveiled the eagerly anticipated 700 series of its Kepler GPU family, announcing upgraded models for both its GTX 680 and GTX 670 video cards. Since these cards are nothing more than a Kepler refresh, Nvidia has both juiced up and watered down existing silicon to fill holes in its lineup and to breathe new life into its gaming arsenal. First up is the new GTX 780, which uses the same GK110 GPU as the company's $1,000 Titan card, and is the replacement model for its former affordable flagship GPU, the GTX 680. Next up is the GTX 770, which uses the same GK104 GPU as the GTX 680, though with much higher clock speeds and faster memory. Both of these models will be offered with the same exotic cooler used by the GTX Titan, so it's clear just by looking at them what their mission in life is—to destroy benchmarks and remove all doubt about which graphics card is the top dog at the $400-to-$650 price point.



Both the GTX 780 and the GTX 770 will be available in classic Titan trim, but unlike Titan they will also be offered with even more audacious aftermarket coolers.



EVGA and other AIB partners are already whipping up snazzy coolers for Nvidia's newest silicon.



The GTX 780 is almost as fast in gaming as a GTX Titan, but lacks the Titan's double-precision compute ability and quad-SLI support.

KEPLER'S SECOND ACT

As we stated in our Tech Preview at the end of 2012, this was always going to be a refresh year for Nvidia, as it hones its Kepler architecture in an effort to squeeze even more performance out of it. This is possible due to the maturity of the 28nm process it employs, and also because Kepler came to market with quite a bit of overclocking headroom, paving the way for new GPUs simply by overclocking existing architecture. Nvidia is also in a fortunate position to have two GPUs to pull from—Titan (aka GK110) at the high end, and the GK104 and its offspring at the middle tier. For this round of cards, Nvidia has taken existing designs and tinkered with SMX modules, frame buffer sizes, and clock speeds. Put simply, the GTX 780 is a slightly detuned and more affordable GTX Titan, while the GTX 770 is basically an overclocked GTX 680. When compared to the GTX 680 and GTX 670 cards they are replacing, both cards promise improved performance, quieter operation via a new Titan-based cooling apparatus as well as new fan technology, and other improvements. Let's take a look at each card first, then dive into the new technology they both employ.

A TITAN MINI-ME

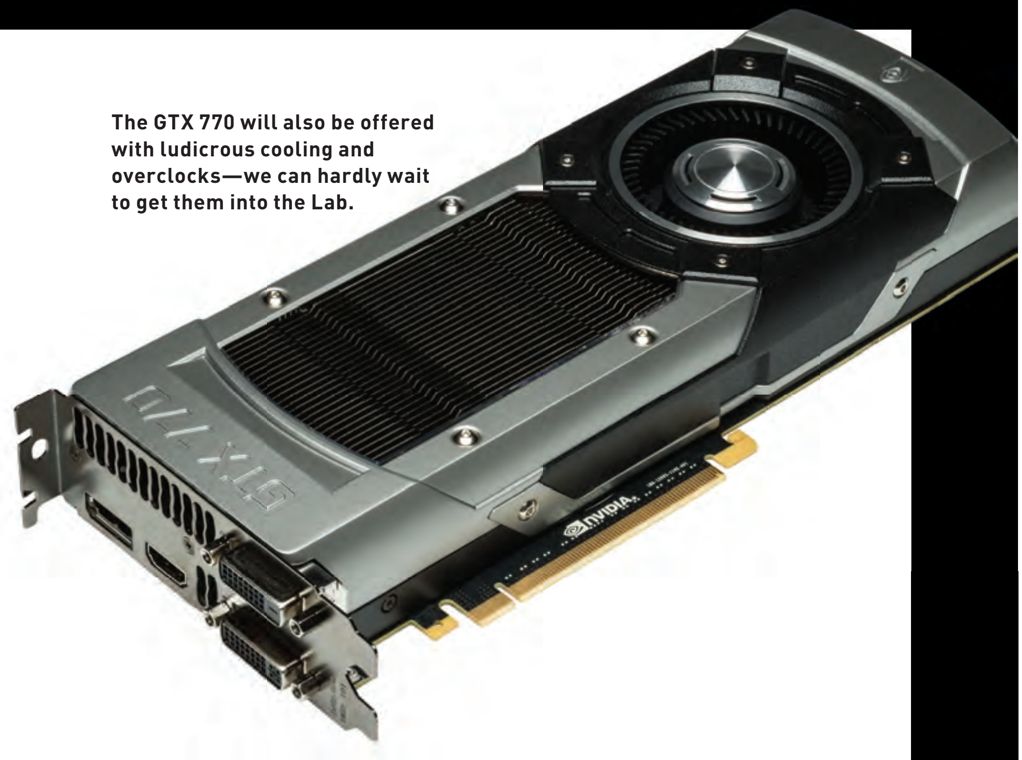
The $650 GTX 780 replaces the GTX 680 as the company's "affordable" flagship GPU, and is the second GPU to spring forth from the company's massive GK110 GPU used in the GTX Titan. Like the Titan, the GTX 780 has 7.1 billion transistors, a 384-bit-wide memory bus, but two fewer SMX clusters at 12, for a total of 2,304 CUDA cores. For comparison sake, the GTX 680 it replaces has a mere 1,536 CUDA cores, so this is quite an upgrade. Its frame buffer has also been upgraded from 2GB to 3GB of memory running at the usual 6GHz clock speed. It's 863MHz core clock speed is just a smidge higher than the Titan's 836MHz clock, and its 900MHz boost clock is also a bit faster than the Titan's 876MHz. Overall, it would be fair to refer to the GTX 780 as the so-called *Titan LE* that has been rumored for a while now, as it's basically a slightly neutered version of the Titan, at least as far as gamers are concerned. Performance in games is extremely competitive with the Titan, more so than we expected, given its price. When it comes to compute performance, however, the GTX 780 is *heavily* neutered compared to the Titan, and for good reason. The 1.5 teraflops of double-precision performance that was so welcome in the Titan is nowhere to be seen in the GTX 780, as Nvidia is keeping

SPECIFICATIONS

	GTX 780	GTX 770	GTX 680	GTX 670	Radeon HD 7970	Radeon HD 7950
Number of Cores	2,304*	1,536*	1,536*	1,536*	2,048*	1,792*
Texture Units	192	128	128	112	128	112
ROPs	48	32	32	32	32	32
Base Clock Frequency	863MHz	1,046MHz	1,006MHz	915MHz	1,000MHz	850MHz
Boost Clock Frequency	900MHz	1,085MHz	1,058MHz	980MHz	N/A	N/A
Memory Clock Frequency	1,502MHz	1,750MHz	1,502MHz	1,502MHz	1,375MHz	1,250MHz
L2 Cache Size	1,536KB	512KB	512KB	512KB	768KB	768KB
Frame Buffer Size	3GB	2GB or 4GB	2GB	2GB	3GB	3GB
Memory Interface	384-bit	256-bit	256-bit	256-bit	384-bit	384-bit
Manufacturing Process	28nm	28nm	28nm	28nm	28nm	28nm
Transistor Count	7.1 billion	3.5 billion	3.5 billion	3.5 billion	4.3 billion	4.3 billion
Connectors	2x DL-DVI, HDMI, DisplayPort 1.2	2x DL-DVI, HDMI, DisplayPort 1.2	2x DL-DVI, HDMI, DisplayPort 1.2	2x DL-DVI, HDMI, DisplayPort 1.2	2x Mini-DisplayPort, DL-DVI, HDMI 1.4a	2x Mini-DisplayPort, DL-DVI, HDMI 1.4a
Power Connectors	1x 6-pin, 1x 8-pin	1x 6-pin, 1x 8-pin	2x 6-pin	2x 6-pin	1x 6-pin, 1x 8-pin	2x 6-pin
Thermal Design Power (TDP)	250W	230W	195W	170W	250W	200W

*AMD and Nvidia core counts are not directly comparable.





The GTX 770 will also be offered with ludicrous cooling and overclocks—we can hardly wait to get them into the Lab.

that feature exclusive to the pricier Titan, and is also billing the GTX 780 as strictly a gaming card. The GTX 780 still offers respectable single-precision performance, though, clocking in at 4 teraflops compared to the Titan's 4.5 teraflops. For comparison, the GK104-based GTX 680 can push only 1 teraflop of single precision, and its double-precision performance is just 1/24th of that by Nvidia's design. It wants these "cheap" cards to be used for gaming, period, and its expensive Tesla cards to be used for compute duties. This is why the Titan costs $999, and the GTX 780 costs $650. Otherwise, the card looks, feels, and runs almost exactly like a Titan. It has the same 10.5-inch length, the same 6-pin and 8-pin PCIe connectors, and the same HDMI, DisplayPort, and DVI connectors. It supports up to three-way SLI, with four-way SLI reserved solely for Titan. The minimum power supply required is 600W, and the card's TDP is 250W, just like the Titan. Unlike the Titan, however, the GTX 780 will be offered with custom cooling solutions that run the gamut from Gigabyte's triple-fan OC edition to the dual-fan ACX version from EVGA. We expect other partners such as Asus to introduce custom-cooled boards, as well.

GK104 TAKE TWO

Though we'd all love to have an entire video card lineup consisting of nothing but Titan GPUs, cost and exclusivity considerations mean that ain't gonna happen. Nvidia doesn't want to cannibalize its own products, so on the high end we get just the GTX 780 for gaming and the Titan for those with deep pockets who need the compute performance. The rest of us have to work with the GK104 GPU, which is certainly no slouch, and arrives in overclocked form to hold it down at the $400 price point.

Compared to the GTX 670 it replaces, which was also based on the GK104 GPU, the GTX 770 offers a substantial clock-speed increase of 131MHz, and a 78MHz bump on the boost clock. Memory speed has also been pumped up to 7GHz, making it the fastest memory to ever ship on a consumer-level graphics card. These upgrades allow the GTX 770 to offer a lot more memory bandwidth over the GTX 670, going from 192GB/s in the 670 to 224GB/s in the 770. The frame buffer remains the same at 2GB, but add-in board partners will be producing 4GB models too, for folks who want to run super-high resolutions. The CUDA core count has also jumped from 1,344 to 1,536, as has TDP from 170W to 230W. The GTX 770 still requires only a single 6-pin and a single 8-pin power connector. In stock trim, it looks just like a Titan, but add-in board partners have already begun to produce exotic variants with even bigger heatsinks, multiple fans, and even higher overclocks.

FANCY NEW TECHNOLOGY

Nvidia knows it can't simply play roulette with its existing silicon's clock speeds and call it a day, so it's also added new features and new technology to both the GTX 780 and 770 in order to entice upgraders. Let's take a look at these new bits of tech one-by-one.

ADAPTIVE FAN CONTROL

Since both the GTX 780 and the GTX 770 use the same cooling apparatus as the GTX Titan, and we didn't really have any complaints about its operation, you would think Nvidia would have just left it alone, but you would be wrong. Though the cooler itself still features the same overall design in that it utilizes a vapor chamber on top of the GPU with a huge heatsink and "blower"-type fan along with an aluminum shroud, Nvidia has changed the fan controller to affect just one aspect of the fan's behavior—how quickly it spins up and down when needed. You see, Nvidia tells us that it's not necessarily fan noise that people notice as much as *changes* in fan speed, and we have to say there's some truth in that. Once a fan is spinning at a certain RPM, we tend to not notice it, but it is certainly noticeable when a fans spin up or down suddenly; we all hear that. Thus on its new GPUs, Nvidia has smoothed out the speed at which the fans spin up and down, so you don't hear the change in fan speed. In practice, it works very well since the Titan cooler is already quite effective, making both the GTX 780 and 770 as close to silent as you can get for cards with this much power.

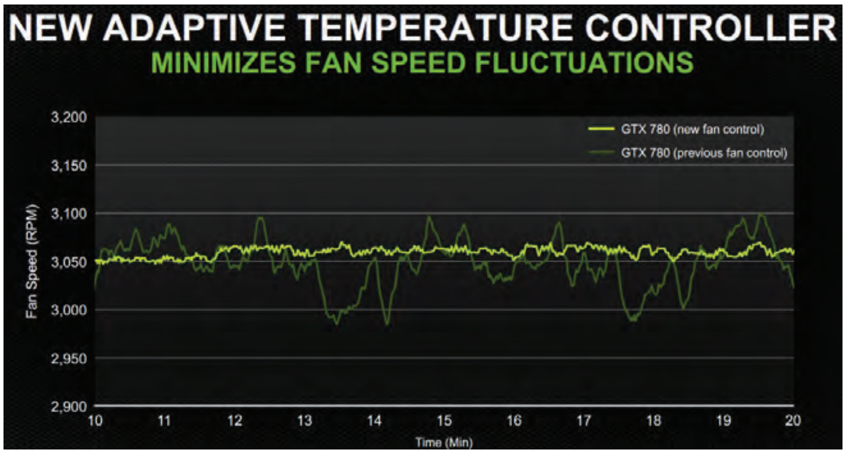
SHADOWPLAY DEBUTS

ShadowPlay is a cool bit of new software, albeit one we have not tested, as it was not available as we went to press. It records your gaming session, using the Kepler GPU's built-in H.264 video encoder—hence its name: It follows your every action, like a shadow. You can tell the software to keep just the last five minutes, 10 minutes, or 20 minutes, and it will intelligently delete what is not needed, keeping file sizes down by both deleting unneeded video and also through video compression. Nvidia also claims the performance hit from turning on ShadowPlay is less than 5 percent, so it's main advantages over FRAPS are that it only records what just happened instead of everything, and that it requires less system resources to do so. This software will be rolling out this summer, available via Nvidia's GeForce Experience software, and will be supported on any Kepler GPU. It should be noted that beginning with this

launch driver, the GeForce Experience software will replace the Nvidia Update software in the driver package, and though users can opt out of installing it, by default it will be installed with all Nvidia drivers going forward. Beginning with the 320 series, during installation of your Nvidia drivers, you'll be asked whether you want to install the GeForce Experience software, so choose whatever floats your boat.

GPU BOOST 2.0

This feature first appeared on the GTX Titan, and is present in both of Nvidia's new GPUs, allowing the user total control over every aspect of how the GPU operates. The biggest difference between GPU Boost 2.0 and 1.0, however, is that the newer version allows you to control the maximum temperature the card can reach, which lets you essentially dictate the noise level of the card according to your preference. By default, the maximum temperature is set to 81 C, but it can be pushed to 95 C if you like (the card can handle it). Nvidia tells us these cards can go all the way up to 105 C before the hardware is damaged, but you'd be lucky to push either of these cards past 80 C typically, since their coolers are so effective. However, the GPU will overclock as high as it can until it reaches that predetermined temperature, at which point it will throttle itself to avoid spiraling temps. GPU Boost 2.0 also allows for overvolting a card, so you can overclock it as high as you can get away with by pushing the core clock power target, temperature target, memory, and voltage. Only the Titan, GTX 780, and GTX 770 offer this technology at this time. If you try to use it on a GTX 680, for example, it's simply grayed out.



Adaptive Fan Control smooths out the speeds at which the fan spins up and down, reducing the amount of discernible noise coming from the GPU—and it works, too.

PERFORMANCE

As far as the GTX 780 is concerned, we see Nvidia making a very bold move with its release. This is a card that offers gaming performance that's extremely close to the GTX Titan, for $350 less, which is an amazing deal if you can afford it. It also should cement Nvidia's leadership in the single-GPU market at $400 and beyond, unless AMD can pull one hell of a fast rabbit out of its hat sometime soon. Not only is the GTX 780 fast, it's also surprisingly quiet, though given the performance of Nvidia's recent cards, we'll probably drop the "surprisingly" line from future reviews, as we're growing accustomed to silent op-

YOUR MOVE, AMD

Will the Radeon HD 8970 please stand up?

AMD has been surprisingly aggressive so far in 2013, both with hardware announcements and with its game bundling. Not only has it shipped the HD 7990 and the HD 7790, as well as secured hardware deals for the Xbox One, PlayStation 4, and Wii U, but it's also secured marketing deals with a slew of triple-A games including Crysis 3, Far Cry 3, Tomb Raider, BioShock Infinite, and more. It also poached several high-profile executives recently from Apple and Nvidia to come over to its GPU division, so the company seems poised to fight Nvidia tooth and nail in the GPU space, which would mean we should see some new AMD silicon very soon, namely the 8000 series GPUs. Rumors indicated the HD 8970 flagship will cost $600 and offer 2,304 stream processors, 6GB of 7GHz memory, and a 1,200MHz clock speed. Reports speculate this card will be roughly 35 percent faster than an HD 7970 GHz edition, which would make it highly competitive with the GTX 780—if the specs are true, that is. There's also murmurs about an HD 8950 at $400 that will offer 1,792 processors, 4GB of 7GHz memory, and also running at 1,200MHz. This card will be roughly ten percent faster than the 7970 GHz. Though we're not sure if the listed specs are a pipe dream or not, leaked AMD roadmaps pointed to new hardware in Q3 of 2013, so it looks like the GPU wars are about to heat up in a very big way.

eration from Nvidia's cards regardless of their horsepower. As it stands, the GTX 780 represents a decent upgrade from the GTX 680, though, as always, people with one GTX 680 would be better off just getting a second card for SLI, as it will be faster than a single GTX 780. The GTX 780 is also notable in that it's the first sub-$1,000 card we've tested that can run most of the games we test at 2560x1600 with 4X AA enabled, which is a tall order for any single GPU, and one the GTX 680 was not quite able to pull off. Even though we'd prefer to have at least 40–50fps, that's just not possible with a single GPU at the resolution we run, and only the Titan can come close to achieving it. That said, the GTX 780 is damned close, and easily puts some distance on both the GTX 680 and the Radeon HD 7970, making it the fastest sub-$1,000 GPU available at this time. We're also royally pumped to test some of the overclocked GTX 780s, as they will surely be right next to the Titan in terms of gaming performance, but certainly not for compute duties.

The GTX 770 is a bit harder to rationalize, but the basic argument is you get slightly better performance than the GTX 680 for $100 less, though the introduction of this card will surely drop the latter card's prices to a similar range, making the two very evenly matched. The angle then is that you get GPU Boost 2.0, which helps the card run quieter, and the GTX 770 will offer a 4GB option, which helps give it more of an advantage, but not in a slam-dunk fashion. This card also puts some pressure on AMD's HD 7970, as it's just as fast, and less expensive. The GTX 770 is a great card for those running 500-series cards with 1080p monitors, though, as it should be able to max-out those settings no problemo.



Like the Titan, both new GTX cards let you set a maximum temperature for the card, allowing it to remain silent at all times if you so desire. Overvolting is also allowed.

FINAL THOUGHTS

In case you couldn't already tell, we're extremely stoked for the GTX 780 since it's basically an affordable version of the record-breaking GTX Titan. Though $650 is still a lot of scratch to drop on a GPU, it's a heck of a lot more affordable than the Titan's $1,000 price tag. Nvidia knows the Titan is a rare card that can be used for a lot more than just gaming given its compute prowess, so $1,000 is somewhat a bargain for that crowd, and Nvidia won't be changing the price of that card for some time, if ever. But it has thrown less affluent gamers a bone with the GTX 780, although you will still need to be a semi-baller to afford one—but since when has top-shelf performance ever come cheap?

Moving onto the GTX 770 the decision becomes a bit less clear, as unlike the GTX 780, this card faces some stiff competition both from the GTX 680 and the AMD HD 7970. With AMD cranking out sweet game bundles like a triple-A title Pez dispenser, it's hard to ignore the red team's gravitational pull on budget-conscious gamers these days, so we think the GTX 770 will be a harder sell. As it stands, it's certainly a really fast card at $400, but not by a big enough margin to declare a knockout victory over any of its rivals.

BENCHMARKS

	GTX 780 (Reference)	GTX 680 (Reference)	PowerColor AMD Radeon HD 7970 GHz	GTX 770	Asus GTX 670 DirectCU II	XFX AMD HD 7950
Driver	320.18	314.22	13.5 Beta 2	320.18	320.18	13.5 Beta 2
3DMark Fire Strike	**8,482**	6,456	7,138	6,932	**5,912**	6,099
Unigine Heaven 4.0 (fps)	**35**	23	23	**24**	21	20
Crysis 3 (fps)	**24**	17	17	17	16	17
Shogun 2 (fps)	**48**	38	38	**39**	33	34
Far Cry 3 (fps)	**35**	30	33	**30**	28	17
Tomb Raider (fps)	**25**	18	22	**20**	16	18
Metro: Last Light (fps)	**22**	16	12	**17**	15	12
Battlefield 3 (fps)	**53**	34	41	**38**	35	35
Catzilla Beta	**6,933**	5,255	4,592	**5,604**	5,374	4,024

Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P9X79 motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 7 Ultimate. All games are run at 2560x1600 with 4X AA except for the 3DMark tests.

iFixit presents:

AUTOPSY

THIS MONTH WE DISSECT...

Ouya Game Console



About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.



BACKGROUND:

Ouya's $99 Android-powered system is touted as "the first totally open video game console," and comes complete with free software development tools. Here, we delve deep into the hardware that powers this little device.

MAJOR TECH SPECS:

- Nvidia Tegra 3 processor
- 1GB RAM
- 8GB of internal storage (expandable via USB)
- Wi-Fi and Ethernet capability
- Bluetooth-enabled gamepad

KEY FINDINGS:

- After removing a hex screw, the top panel comes off easily, revealing a clean and simple layout. The motherboard, I/O ports, and fan are tucked into the console as a single assembly.

- Extracting the motherboard/fan assembly simply requires pulling it away from the case assembly.

- The fan is the only modular, easily removed component in the box—that's OK, it's also the only moving component, subject to wear. Held in by four Phillips screws and a plug, the fan is a standard, off-the-shelf part, so you can easily replace it.

- To remove the heatsink from the processor, our trusty soldering iron and desoldering wick was required. According to an Ouya engineer, solder was chosen over clips for mechanical strength, as they were (rightfully) worried about such a small console being knocked around or dropped.

- Onto the controller: Two pieces of the top casing of the controller easily separate from the body, no tools required—convenient for dropping in fresh batteries (2x AA). A few Phillips screws provide entry into the controller itself, where we find a stack of two circuit boards: The top hosts contacts for the directional pad and "O, U, Y, A" buttons, while the lower is home to the two analog joysticks.

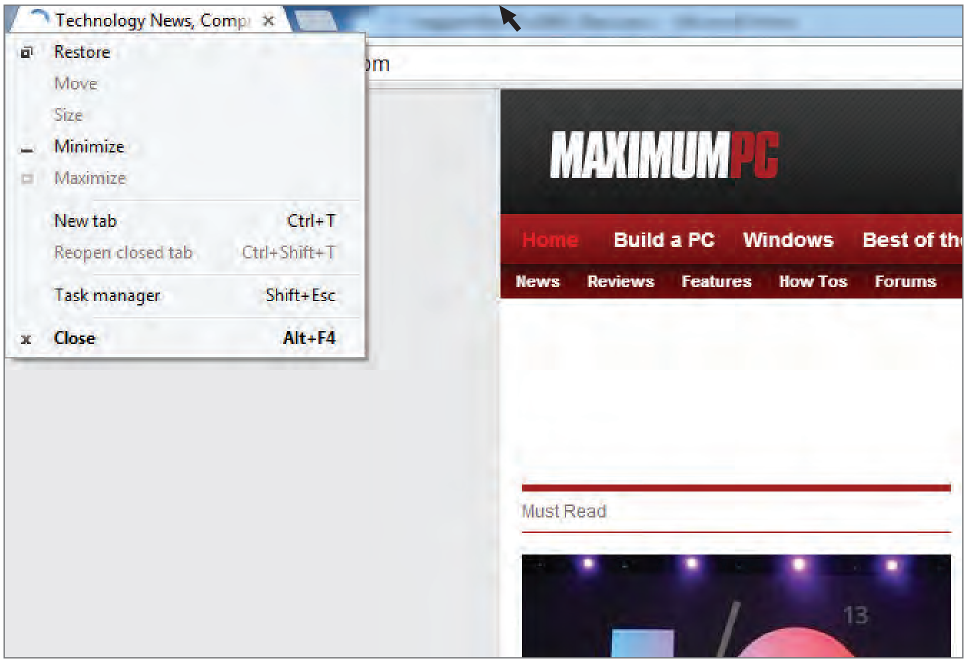
- Underneath the top button board, we find a lone IC, charged with running the entire controller: The Broadcom BCM20730 Bluetooth 3.0 transceiver features an integrated ARM Cortex M3 processor, capable of reading all of the button and joystick inputs and sending them off into the ether (or really, back to the Ouya console).

- Repairability score: 9 out of 10. The batteries are standard AA, and easy to access and replace without tools; only standard-head screws are used (Phillips and hex); many components are modular and simple to remove; the heatsink is soldered in place, so if you need to replace the thermal pad, or repeated fan-swapping strips the threads, you'll need some soldering skills; the joysticks are soldered to the circuit board, so if your button-mashing gets out of hand, you may need to replace the whole board.

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

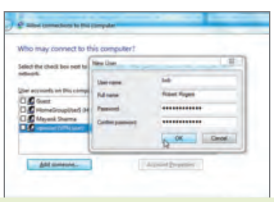
WINDOWS TIP OF THE MONTH

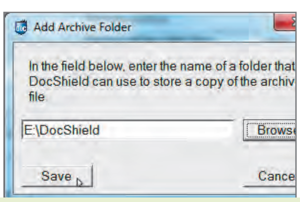


CLOSE A WINDOW FROM THE UPPER-LEFT CORNER

In Windows, if you click in the upper-left corner of any standard window, a small dialogue box opens, with a number of basic options for that window. If you click again without moving the mouse, the window will close automatically. Especially on a trackpad, this can be faster than carefully hitting the X in the upper right-hand corner.

MAKE - USE - CREATE







ALEX CASTLE
CONTRIBUTING EDITOR

HOW TO MANAGE CHROME'S TABS

HAVE YOU ever found a solution to a problem you've been having, and found that instead of relief, you feel frustrated that it took you so long to find it? I had that feeling this month, when I discovered the simple fix for a problem that's always bugged me—too many Chrome tabs eating up my memory and slowing down my PC.

Though I had been vaguely aware of tab management extensions, which have been around for years, it never occurred to me that one might be the answer to my problems. If you're in the same boat, let me encourage you to try out a tab manager like OneTab (Chrome, www.one-tab.com) or TooManyTabs(Chrome and Firefox, www.visibotech.com/toomanytabs), which allow you to get the masses of tabs you have open out of your computer's memory, without having to completely lose track of them.

↘ submit your How To project idea to: comments@maximumpc.com

Create a VPN Server

YOU'LL NEED THIS

TWO WINDOWS PCs
You won't need any special software for this guide, but you will need two computers running Windows 7 or 8—one to act as a server, one as a client.

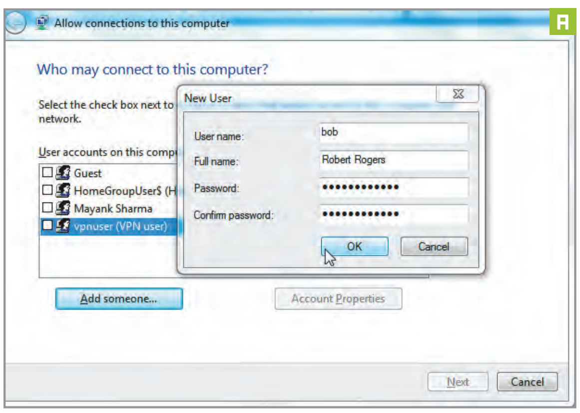
USING A VPN—or virtual private network—you can remotely connect to a private network from an unsecure public network, via secure virtual "tunnels." VPNs are primarily used by businesses to allow their employees to connect to the office network from home—but it also has interesting applications for casual users. For example, you can use it to access your computer at home and watch region-locked TV streams.

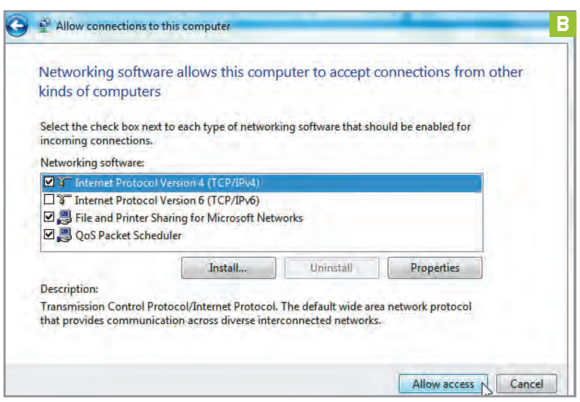
Setting up a VPN can require some serious system administration skills and dedicated networking tools, but Windows 7 comes with everything you need to set up and configure your PC as a VPN server—as well as the tools to connect to it as a client. That said—as with any network software—the process of setting up a VPN server requires knowledge of your network infrastructure at home. It may sound daunting, but we'll walk you through it. –MAYANK SHARMA

1 PREPARE YOUR USER ACCOUNTS We'll start by setting up the machine we want to access remotely. First, we need to create a new incoming connection. Click Start and type **view network connections** in the Search box. Click any option to open the Network Connection window. Press the Alt key, open the File menu, and select New Incoming Connection....

» You'll be shown a list of all the users on this machine. Select the user account you wish to be able to connect to from a remote computer. Since existing user accounts may have administrative privileges, you should create a new user with limited privileges specifically for accepting VPN connections. Click Add Someone... and specify the account details of the new user (**image A**).

» Click the Next button after adding a user. Then select the Through the Internet checkbox, which defines how people will connect to this machine. Next, you'll be shown a list of network services that will be enabled for remote users. You can now proceed with the default options, or remove access such as "File and printer sharing" if you don't want remote users to use them (**image B**).



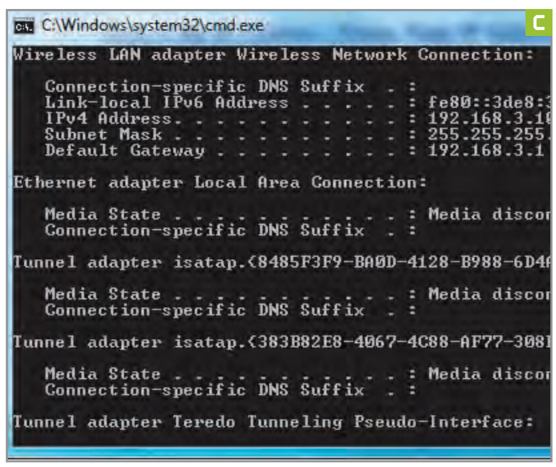


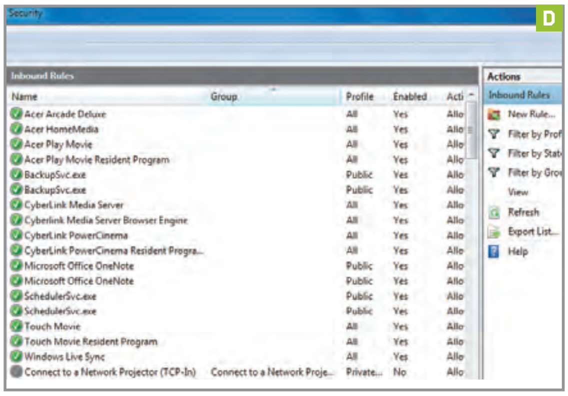
2 CONFIGURE THE VPN SERVER To allow VPN connections, you need to check your router and Windows firewall. For that you need to know the private and public IP addresses of the Windows VPN server. Click Start and type **cmd**. In the terminal window that opens, type **ipconfig** and note the address listed in the line starting with IPv4 Address (**image C**). To find the server's public IP, go to www.google.com and search for **my IP**.

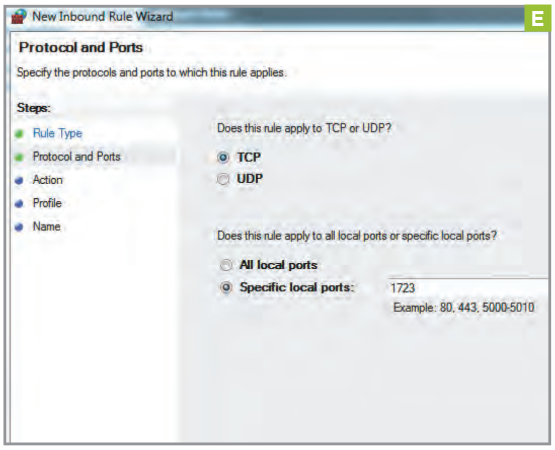
» To ensure Windows Firewall doesn't block VPN connections, we need to configure it. Begin by clicking Start > Control Panel and type **firewall** into the search box. Click Windows Firewall, then click Advanced Settings in the left-hand pane. You might be prompted for your Administrator password before Windows launches Windows Firewall with Advanced Security.

» Using this dialog box, you need to add a new rule to allow traffic on the VPN port 1723. In the left-hand pane click Inbound Rules and then in the right-pane click New Rule (**image D**). Next, toggle the Port radio button on the wizard screen. In the next step, toggle the TCP option and then enter the VPN port number in the space provided (**image E**). Use the default options for the rest of the wizard.

» Now, it's time to configure your router to forward connections from the Internet to the server. The instructions for this step depend on your router. Check www.portforward.com for router-specific information. The two things you need to know to are the VPN port number (1723) and the private IP address of the server that you found above. The server is now set up!





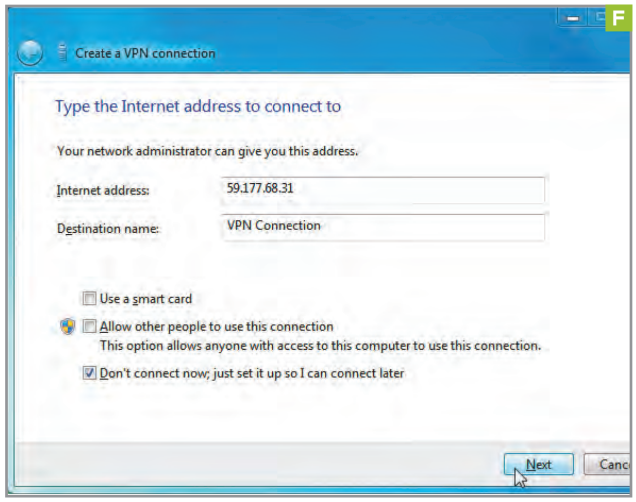


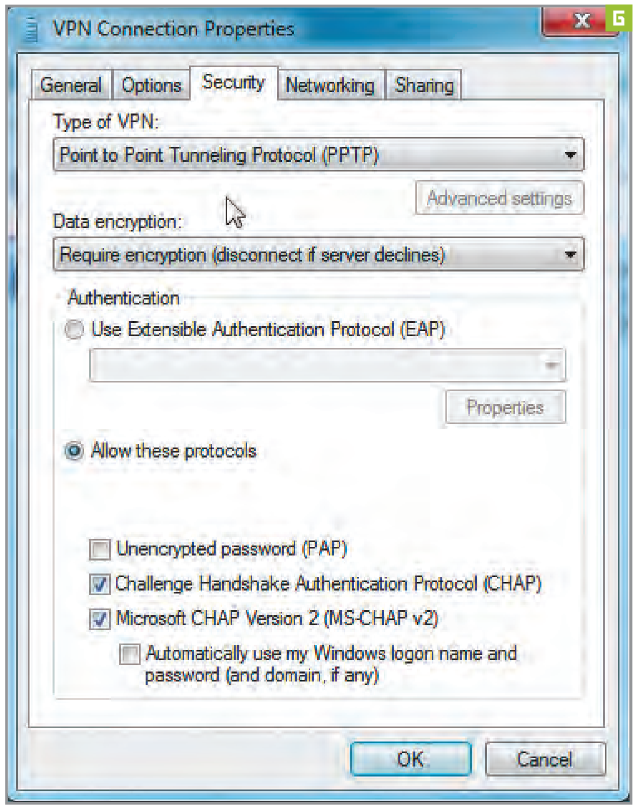
3 CONNECT WITH A CLIENT MACHINE

CONNECT WITH A CLIENT MACHINE When you want to connect to the VPN server from a remote location, you need to first create a new connection on the client machine. Go to Start and type **vpn** in the search box and select the first option that comes up. In the dialog box that appears (**image F**), type in the public IP address of the VPN server and give it a name. Don't forget to select the "Don't connect now" checkbox.

» You'll then be prompted for the credentials of the VPN user you set up in step one. The new VPN connection will now be listed next to other regular connections in the Network Connection window. Right-click this connection and select Properties. Now, switch to the Security tab and select the PPTP option from the Type of VPN drop-down menu and click OK (**image G**).

» That's it! You can now double-click this new connection, enter the password for the VPN user, and click Connect. You'll then be connected to the remote VPN server. On the VPN server, you can see the number of connected users in the Network Connection window. To disable VPN access to the server, simply right-click the Incoming Connection item and select Delete.





Restore Your Files with DocShield

YOU'LL NEED THIS

DOCSHIELD
This document recovery program is free for personal use. Get it at www.docshield.com.

DOCSHIELD IS an amazingly useful program that will allow you to restore earlier versions of the same file in seconds. Never again will you have to painstakingly reverse all changes made to a document, or try to remember the original draft and undo your botched rewrite. Now, you can pick an earlier revision of the file and either restore it over the current version or save it as a separate file and work on it independently.

The idea of backing up multiple revisions of a file certainly isn't new—it's even built into Windows 7 in the form of Shadow Copy. Many online backup tools make it possible to restore earlier versions of a file, too—but the key advantage of DocShield is that you're in complete control of when backups are created, and exactly which files and folders get backed up. Read on to discover how this versatile program can help protect your data in the future. –GILES CUMBERBUND

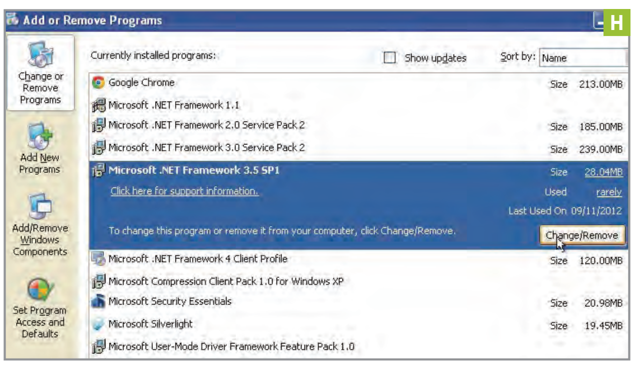
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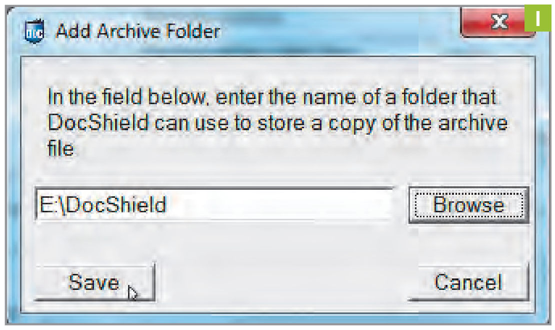
START BACKING UP FILES DocShield requires that Microsoft .NET Framework 2.0 or later is installed—it's included in Windows 7 and Vista, but Windows XP users should check the Add or Remove Programs Control Panel (**image H**). If it's not there, click Start > All Programs > Windows Update and perform a custom scan to download and install it. Once it's in place, download and install DocShield from www.docshield.com.

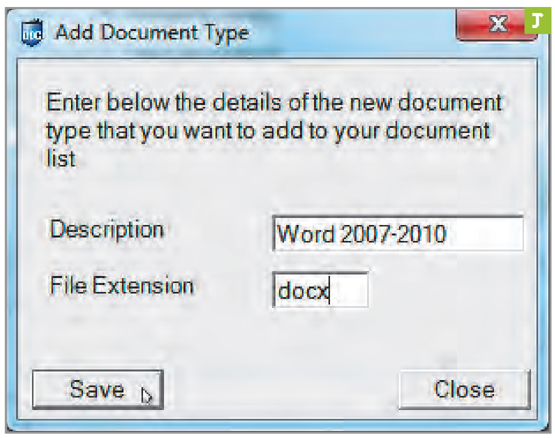
» Once it's installed, double-click the DocShield desktop icon and click Yes or Continue when prompted. Read the warning about setting up your backup device. Click OK and switch to the Options tab, then click the plus button under Archive File Destinations, followed by Browse. Select or create a suitable folder on your backup drive, then click OK followed by Save (**image I**).

» Use the Document Add-On section to pick specific file types to protect (**image J**). To protect them, you can either check an existing document type such as .doc or .txt, or click the plus button to add your own. If adding your own, enter a suitable description and the file extension (minus the period before it) and click OK—it will appear at the bottom of the list, pre-selected.

» One folder—C:\Documents and Settings—is selected by default in the "Folders to monitor" box. This may cause error messages in later versions of Windows, so select it and click the minus button to remove it. Now click the plus button to select the folders containing documents with versions you wish to back up. Check Subfolders to ensure that everything inside the folder is protected.





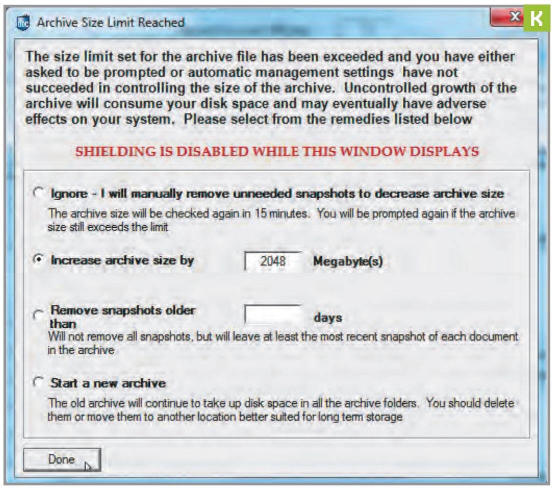


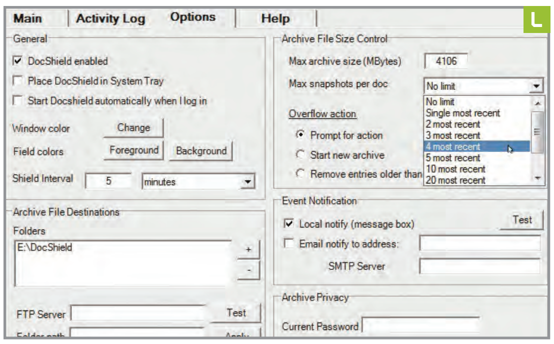
2

TWEAK DOCSHIELD SETTINGS By default, DocShield limits the total backup size to just 10MB, which means it'll probably be full within seconds of launching. An Archive Size Limit Reached window will appear with a number of options to choose from; the best idea is to increase the size of the backup archive (**image K**). Add as much space as you can spare—start with an extra gigabyte or two.

» By default, DocShield scans for file changes every five minutes, backing up any files that have been modified in that time—adjust the Shield Interval setting to make

this scan more or less frequent. Also consider limiting the number of version backups kept for each file by clicking the "Max snapshots per doc" drop-down menu and choosing the number to keep (**image L**).





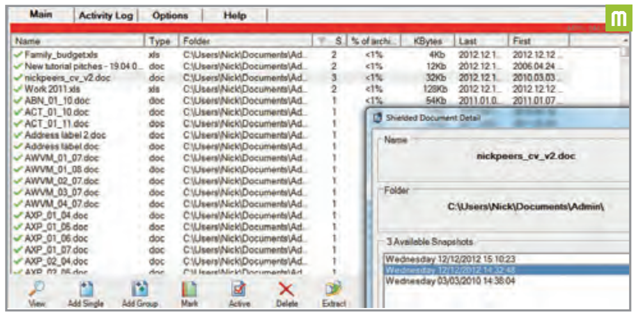
RESTORE AN EARLIER VERSION OF A FILE

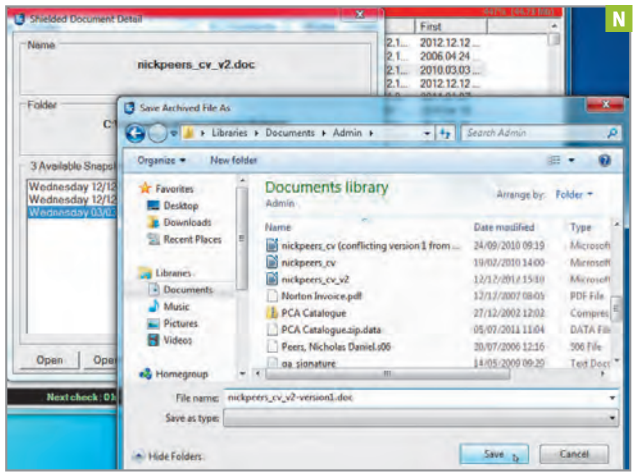
3 **RESTORE AN EARLIER VERSION OF A FILE** When you want to restore a previous version of a file, switch to the Main tab. Locate the file's entry in the list and double-click it—a window will open listing all versions of the file that have been backed up (**image M**). Select the one closest to the date or time you want to roll back to and click Open to preview it in Microsoft Word or whatever its default application is.

» Once you've checked the file, click Close. If it's not the right version, try another until you find the version you want, or a version close to what you're looking for. With this version selected, click the Save As button. To replace the current version with this earlier revision, simply double-click its file name in the list and click Yes when prompted.

» Alternatively, you can give the file you wish to restore a new name so it will be saved as a copy alongside the current version. Make sure you include the file extension when typing its name—filename_v2.doc, for example—before clicking Save (**image N**). Once the file has been restored, you can click Close to return to the main DocShield screen.

» Well done. You've successfully configured DocShield to not only back up your critical documents and other files, but different versions of the same file, too. That means you can happily edit a file knowing that should the need arise, you can easily revert to an earlier copy without having to spend precious time painstakingly undoing all your recent changes.





BUILD IT

TOM MCNAMARA **ASSOCIATE EDITOR**



A Real-World Haswell, GTX 780 Rig

This month, we built a Haswell rig into an ATX chassis, and added the mini-Titan GTX 780 to create a badass, silent, next-gen gaming PC

LENGTH OF TIME: **2–4 HOURS** | LEVEL OF DIFFICULTY: **INTERMEDIATE**

THE MISSION This month, Intel's "Haswell" generation of desktop CPUs landed in the Lab, so like most builders, we were itching to see how she runs. For the uninitiated, Haswell is an upgrade from Ivy Bridge in terms of power efficiency and performance, but it also comes with a whole new motherboard socket—Socket 1150. We were curious to see if our building regimen would require any adjustments. As luck would have it, Nvidia also launched its 700-series cards this month to much fanfare, and since both of these components are going to be popular parts for upgraders and system builders, we decided to jump into the deep end of the pool with both of them and see how the combo performs in gaming benchmarks.

On the CPU front, we went with Intel's Core i7-4770K, a quad-core chip with Hyper-Threading. The video card we used is the Nvidia reference GTX 780, basically a slightly watered-down GTX Titan. We also threw in a new SSD from SanDisk, a low-noise case from Thermaltake, an alternate drive installation method, and an oversized air cooler. Our goal was to build a quiet, Haswell-based gaming rig that would give our zero-point a run for its money.



ASSEMBLING THE SUPER FRIENDS

YOU MAY HAVE NOTICED we've been using a lot of cases with sound-absorbing panels lately, and you may think we're crazy, especially since we plan to overclock, but once you've experienced a powerful PC emitting nothing more than a gentle hum, it's hard to go back. This month we tapped the Thermaltake New Soprano (which received a 9/Kick Ass verdict in our February 2013 issue). Its massive 20cm front fan should drag in a lot of cool air, and the 12cm rear fan is no slouch either. We ended up making some modifications to the case's interior layout in order to improve airflow, which we'll talk about later.

To cool our new Haswell chip we went with a Phanteks TC14PE, which is arguably one of the best air coolers around. That should give us some extra headroom to perform overclocking duties, though the cooler's massive size makes low-profile RAM necessary. SanDisk also has a new SSD, the Extreme II, which should give quite a boost to general desktop performance. Though the previous model, simply named Extreme SSD, was a bit of a me-too drive with its SandForce controller, this new drive has an all-new Marvell "Monet" controller and 19nm toggle NAND, so it's primed for high performance. It even uses a tiny bit of super-expensive SLC NAND in addition to traditional MLC in a setup called two-tiered caching, which is supposed to speed up small writes from the OS.

The Intel Core i7-4770K uses Intel's new LGA1150 socket, so we grabbed a brand-new Gigabyte Z87X-UD3H; it's basically the Haswell version of the company's Z77X-UD3H, which has a reputation for allowing high CPU overclocks and being extremely stable.

INGREDIENTS

	PART	PRICE
Case	Thermaltake New Soprano	$120
PSU	Corsair HX750	$130
Mobo	Gigabyte GA-Z87X-UD3H	$180
CPU	Intel Core i7-4770K	$340
CPU Cooler	Phanteks TC14PE	$85 (street)
GPU	Nvidia GeForce GTX 780	$650
RAM	Corsair Vengeance 2x 4GB	$60
SSD	SanDisk Extreme II 240GB	$230
HDD	Seagate Barracuda 3TB	$135
OS	Windows 8 64-bit OEM	$100
Total		$2030

1 IT'S ABOUT TIME

INTEL HAS HAD a "tick-tock" development cycle for its last few generations of desktop CPUs, where each "tock" is a new microarchitecture. Haswell is the latest tock. Each iteration has bumped up performance 5–15 percent, depending on the task. Physically, Haswell is pretty much identical to previous comparable Intel chips, despite changing from an LGA1155 socket to LGA1150. So, we were able to just drop it in like an 1155 chip, dab some thermal paste on top, and use the CPU cooler's installation instructions for LGA1155. We could have gone with the Core i5-4570K, which costs about $100 less than the Core i7-4770K, but none were available as of press time. And the i7 has Hyper-Threading, which is nice for multithread tasks like encoding video.



2 TAKING A BYTE

WE CHOSE the Gigabyte Z87X-UD3H because the Z77 version has a good rep for performance and build quality, and this board improves on it. For example, the SATA 6Gb/s port count has gone from two to eight, which is much appreciated. It also has beefier heatsinks around the CPU socket, but we were able to fit the husky Phanteks TC14PE without any obstructions (albeit with low-profile RAM).

Gigabyte has also finally upgraded its unattractive EasyTune performance-tweaking software. Before, you could only plot two points on a graph to tell the board how to manage your fan speeds. Now you have five, for much finer-grained control. You also finally have several speed presets to choose from. You won't get as much overall tweaking as with Asus's AI Suite II, but the BIOS should have nearly everything you need, though it's still not as easy to navigate as we would like.



3 GOING TO EXTREMES

STORAGE DUTIES are handled by Seagate's 3TB Barracuda, which offers a lot of room for the money and is a snappy performer. It's joined by the SanDisk Extreme 2 SSD, the sequel to a respectable SSD, with the intriguing addition of some internal SLC cache.

We removed the lower drive trays to maximize airflow for the CPU and GPU, and installed the drives in the upper section, which has a 3.5-inch drive bay with storage space for both 3.5-inch and 2.5-inch drives. We had to remove the front fan to extract the slide-out tray through the front of the case. Removing the fan requires removing the front bezel, but it snaps on and off fairly easily.



4 MUSIC TO OUR EARS

THE THERMALTAKE New Soprano is a sleek-looking, low-noise case. The thick front door blocks noise coming from the front fan, which has intakes on the sides. The top and sides of the case do not have fan mounts, but that serves to keep the noise down. Both side panels have sound-dampening foam, with the right side's material being thinner to accommodate cables behind the motherboard. The bottom of the case has a 12cm fan mount if you need more airflow, or if you want to put a water cooler on the CPU or GPU.

The motherboard standoffs are pre-installed, so installation went much quicker. The case has a few rubber grommets to the left of the board, and we had no trouble threading cables behind the board's tray. Our choice of drive installation had the drive connectors facing the rear of the case, so we didn't end up with as clean a look as we would have liked.



5 AN OLYMPIC GPU

RIGHT NOW, the Nvidia GeForce GTX 780 is the second-fastest single-GPU card on the market, behind Nvidia's GTX Titan. It's identical in size, and very close in gaming performance, with the main difference between the two being that the 780 has two disabled SMX units, for a total of 12, and lacks double-precision compute capability. Though we already knew the card was fast from our benchmarks, we were also eager to test the card's heat output and noise levels in a PC that we built from scratch. Subjective tests showed it to be noticeably quieter than the Titan (and like that card, you can select a target temperature or power target according to preference). The back of the case has a bracket that helps hold down the PCI slot covers, so we had to remove that before installing the card.

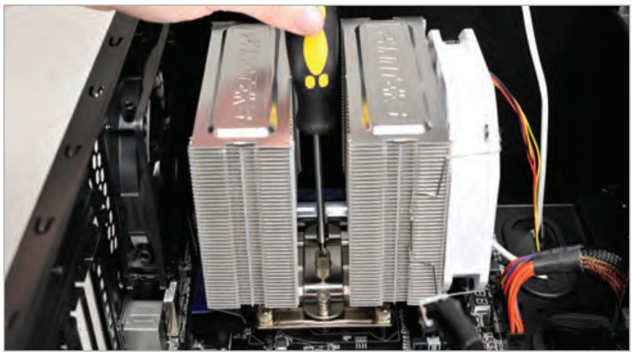
The GTX 780 is 10.5 inches long, so space was a little tight with the storage drives right next to it, but it was manageable. A card that's 11 inches or longer, such as the GTX 690 or HD 7990, would not have fit unless we installed the drives below the card.



6 GO BIG OR GO HOME

AN LGA1155 OR 1150 system with a single GPU should run fine on 500 watts of power, so our Corsair HX750 was arguably overkill, but we like having some power in reserve for hot days. It's also a modular PSU, which is better for cable management. It should also produce highly regulated power for overclocking stability, and it's backed by a 7-year warranty. It felt like a unit worthy of a $325 CPU and $650 video card.

The Phanteks TC14PE CPU cooler is a good value for a dual-fan, dual-radiator unit, allowing us a 4.4GHz overclock without excessive noise levels. A water-cooler might have been better, but the case's limited fan mounts would have left us with too few options to add fans for improved airflow through the system. Also, with an untested CPU, GPU, SSD, and motherboard, we wanted to avoid the unpredictability of a new cooler. The RAM also didn't have to be anything exotic, since games don't tend to benefit from high memory speeds, so two sticks of low-profile 1,600MHz Corsair Vengeance DDR3 RAM did the trick.





1. LGA1150 keeps the same mounting holes used in Lynnfield, Sandy Bridge, and Ivy Bridge, so we were able to use this LGA1155 cooler with no adapter required.

2. Nvidia recommends a 600W power supply minimum for the GTX 780, so we played it safe with this Corsair 750W unit. We always recommend you do the same and give yourself a small power buffer.

3. We installed both mechanical and solid-state storage drives above the hard drive cage in order to avoid impeding the airflow from the case's 20cm intake fan.

4. The Thermaltake New Soprano has sound-absorbing foam on its side panels, which will blunt the noise from the hard drive, CPU cooler, and GPU fan.

HASWELL THAT ENDS WELL

TURNING ON A new PC for the first time is always a tense moment. With a case as quiet as the New Soprano, we had to double-check that we were actually up and running. Once you get a few feet away, this build is basically silent.

Performance was excellent, too. By default, the Core i7-4770K runs at 3.5GHz and can Turbo Boost one or two of its cores to 3.8GHz when it doesn't need all four to be running at full speed. We were able to overclock the CPU Turbo Boost on all four cores to 4.4GHz, which is a pretty good result for a CPU not using liquid cooling. The air cooler's dual 12cm fans helped keep the Haswell CPU stable while also delivering a noise level that wasn't distracting. We tried bumping it to 4.5GHz, but with Prime95 running its gnarliest test, the overclock crossed the 80 degrees C threshold, which is a bit too hot for our tastes, so we settled at 4.4GHz.

Combine that with a GPU core overclock of 150MHz and a GPU memory overclock of 100MHz (effective), and our reference card was benchmarking about 10 percent faster than stock speeds. The GTX 780 put out a lot of heat, but most of it was being blown directly out of the case thanks to the card's blower cooling design. It accomplished this feat despite its fan operating so quietly that it was effectively silent once the case was closed.

The positioning of our storage devices didn't end up being as helpful as we would have liked, since the video card hogged most of the air coming through the intake fan. But the airflow is at least getting to the GTX 780 more quickly, if not the CPU. We had enough airflow to our storage devices, though, as they were both lukewarm, and the SanDisk Extreme II SSD booted quickly and seemed very peppy.

In retrospect, it probably would have been better to go with a more conventional case, or at least one with more fan mounts. For example, if we had two mounts in the top, as with the Fractal Design Define R4 (which is also low-noise), we could have easily put in a 240mm radiator and even set up a custom liquid-cooling loop. Removable drive cages also would have been preferable.

Other than that, the system has a good feel to it. It's rock-solid (after we figured out the right settings for the CPU overclock), runs cool and quiet, and produces blistering performance.

BENCHMARKS

	ZERO POINT	
3DMark Fire Strike	9,448	9,694
3DMark Fire Strike Extreme	4,774	5,013
3DMark11 Performance	15,195	12,647 (-16.8%)
3DMark11 Extreme	5,924	5,096 (-14%)
Batman: Arkham City (fps)	109	75 (-31.2%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

The zero-point machine compared here consists of a 3.2GHz Core i7-3930K, 16GB of Corsair DDR3/1600 on an Asus P9X79 Deluxe motherboard. It has a GeForce GTX 690, a Corsair Neutron GTX SSD, and 64-bit Windows 7 Professional.

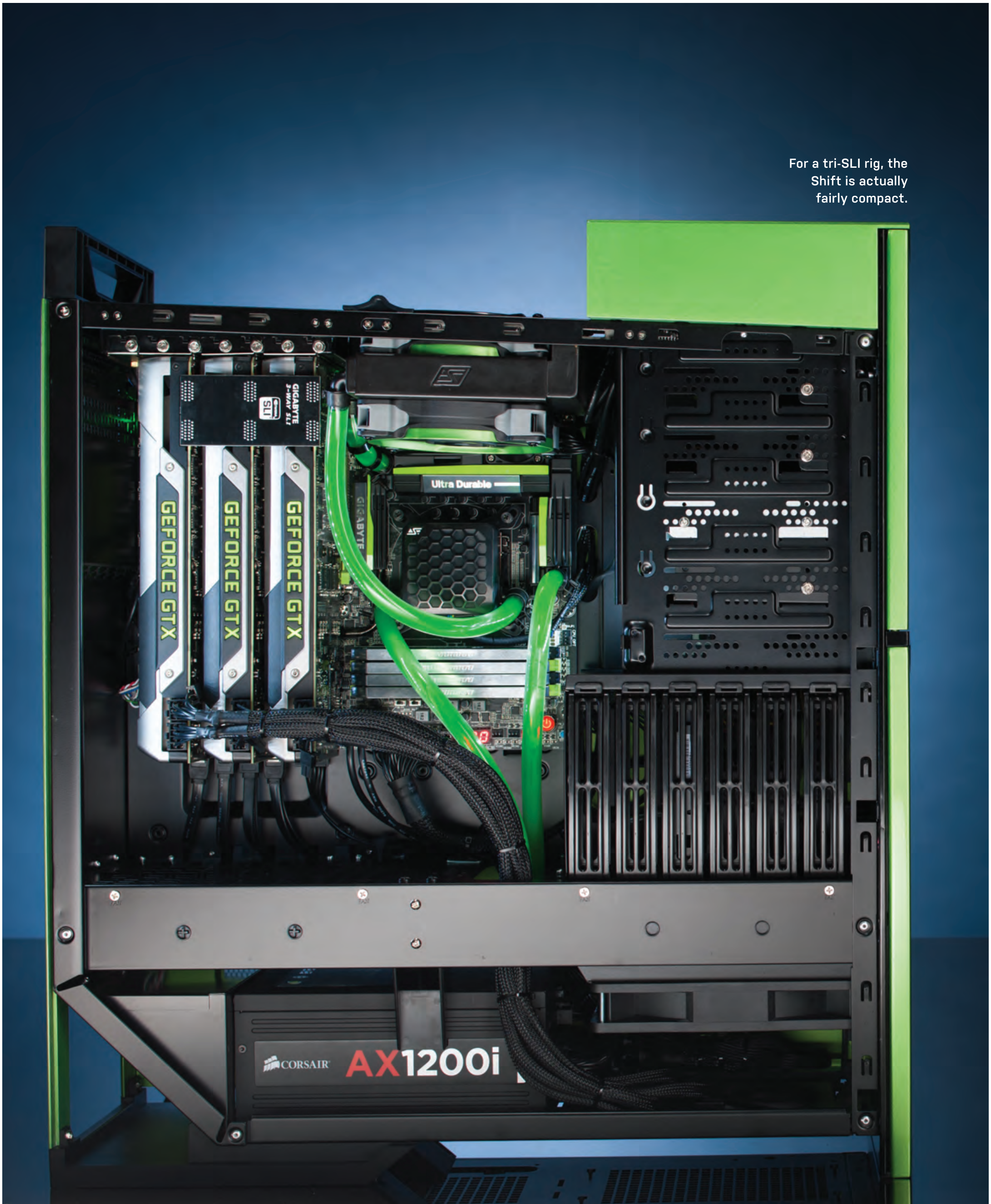
REVIEWS

TESTED. REVIEWED. VERDICTIZED.



INSIDE

MAINGEAR SHIFT SUPER STOCK Z87 PAGE 74



For a tri-SLI rig, the Shift is actually fairly compact.

Maingear Shift Super Stock Z87

A Jolly Green Giant of GPU performance

MAINGEAR CALLS its Shift Super Stock Z87 the Mean Green Machine and it's hard not to agree with that moniker.

Is there any other way to describe a gaming rig with not one GeForce GTX Titan, or even two—but freakin' three of them? Yes, three of the world's fastest single-GPU cards all singing harmoniously together against the tyranny of slow frame rates.

The Shift isn't just about new GPUs, though—Maingear splashes out on other gourmet goodies. There's none of that freeze-dried, last month's Ivy Bridge in this box. It's all Haswell. If you read our coverage on Haswell (page 42), you know we're a little melancholy about the chip because, well, we want more! Perhaps we're being too negative. Months of dour news about the PC world can do that to a nerd. But you know what makes it all better? Speed. And the Haswell-sporting Shift has that.

But, back to the tri-SLI. There have been concerns that, like Ivy Bridge and Z77, the Haswell/Z87 doesn't have the available PCIe 3.0 bandwidth to serve tri-SLI. If that's true, we can't find evidence of it here in the Gigabyte G1.Sniper 5 board. The three Titans easily belted out the highest score we've ever seen in, well, all of our graphics tests. In 3DMark 11, for example, it spit out just under 14,000. How fast is that? Last year's Dream Machine with quad-SLI (two GTX 690s) mustered a mere 10,906. The Geekbox Ego Maniacal mustered but 12,090, with a liquid-cooled quad-SLI setup. The Shift's score in Batman: Arkham City is similarly impressive. The Geekbox Ego Maniacal has held the record with 134fps but the Shift pushes the bar to 184fps. Again, we're not talking about a pair of busted up GeForce GTX 460 cards here—that's a liquid-cooled quad-SLI setup that the Shift easily outpaces.

Like we said, the Shift can deliver on the CPU front, as well. The Core i7-4770K at 4.7GHz snaps the needle in Stitch.Efx 2.0 and ProShow Producer with new benchmark records. We have to point out one obvious thing, though: The Falcon Northwest FragBox 3 reviewed on page 76 ain't that far behind the Shift in the CPU tests. Neither quad-core box, however, can touch the Geekbox's scores in the multithreaded tests such as Premiere Pro CS6 and x264.

One thing we wish Maingear had lifted from Geekbox is its GPU liquid cooling. The Shift's CPU is kept chilly using what the company calls its Epic 300 Open-loop Super Cooler, which doesn't cool just the CPU but also the voltage regulation circuits on the board. That's fine, but the three Titans, when pushed hard for long periods of time, tend to get a little audible, even with a massive fan pushing air straight through them. That's because Maingear overclocks the hell out of the three Titans and picked a very loud fan profile. Apparently, Maingear anticipates people using the Shift in the sweltering summers on Venus. The good news is that you can easily trim the fans back to reasonable levels in the nifty EVGA utility that comes pre-installed.

An even better solution is liquid cooling, but it's very, very hard to argue with graphics performance that crushes even quad-SLI systems. That's no small accomplishment and demands respect.

–GORDON MAH UNG

VERDICT 9 KICK ASS!

Maingear Shift Super Stock Z87

➕ **SIMPLE GREEN** Record-breaking graphics performance.

➖ **SIMPLY RED** A bit noisy; pricey.

$7,800, www.maingear.com

BENCHMARKS

	ZERO POINT	
Premiere Pro CS6 (sec)	2,000	2,100 (-5%)
Stitch.Efx 2.0 (sec)	831	636
ProShow Producer 5.0 (sec)	1,446	1,108
x264 HD 5.0 (fps)	21.1	20 (-5%)
Batman: Arkham City (fps)	76.0	184 (+142%)
3DMark 11	5,847	13,901 (+138%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

SPECIFICATIONS

Processor	Intel Core i7-4770K@4.7GHz
Mobo	Gigabyte G1.Sniper 5
RAM	32GB DDR3/2400
Video Card	3x GeForce GTX Titan
Sound Card	Onboard
Storage	256GB Samsung 840 Pro SSD, Seagate Barracuda 4TB HDD
Optical	LG 14N540 BD-RE
Case/PSU	Custom / Corsair AX1200



The FragBox 3 goes all SSD with 2TB of solid-state goodness inside.

Falcon Northwest FragBox 3

The fastest SFF rig we've ever tested

THERE'S LONG been a rule that no matter what, the tower computer's dominance over the small form factor can't be overcome.

Why? It's simple math: You can't expect an SFF with a third the space of a big-ass tower to keep the same amount of hardware cool. While that's still mostly true, Falcon Northwest's FragBox 3 gets about as close to a tower's capabilities as we've seen yet. The FragBox 3 packs in Intel's wickedly fast new Core i7-4770K clocked up to the 4.6GHz range. And just to show the popular new mini-towers that they ain't got nothing on it, the FragBox 3 totes not one, but two GeForce GTX Titan cards. And in a somewhat controversial storage decision, Falcon opted to go all solid-state with the configuration it sent us, which sports a pair of 960GB Crucial M500 SSDs in RAID 0 and no hard drive. Have we truly crossed the line on mechanical drives? With 2TB of fast SSD performance, maybe we have.

Performance is where the FragBox 3 gets interesting. In graphics, SLI can't beat tri-SLI, but in content creation, the FragBox 3 came within a hair of the larger Maingear Shift (page 74), which itself set records in two CPU benchmarks. In fact, if it wasn't for the Shift, the FragBox 3 would be the fastest rig we've tested in ProShow Producer and Stitch.Efx 2.0. Yes, in other words, this SFF beats massive hexa-core towers in performance. In the other compute-bound benches, the FragBox virtually ties the Shift, meaning it's pretty much its performance equal.

In graphics, the FragBox 3's SLI Titans are stupidly fast, with only quad-SLI and tri-SLI Titans outpacing it. What the FragBox 3 also has over the Shift is acoustics. The FragBox's Titans are mildly overclocked and the fan profiles make the machine amazingly quiet for the graphics performance it has. The same can't be said of the Shift out of the box; it must be dialed back to make the GPU noise tolerable.

We can't say the FragBox is the fastest all-around PC we've ever tested since, well, the tower still has an edge here, if not by a lot. What we can say is that the FragBox 3 is the fastest small form factor rig ever to grace our lab.

–GORDON MAH UNG

VERDICT 9 KICK ASS!

Falcon Northwest FragBox 3

+ FRAGFEST It's simply the fastest SFF in town.

− INFEST Pricey; are we really beyond mechanical drives?

$5,243, www.falcon-nw.com

BENCHMARKS

	ZERO POINT	
Premiere Pro CS6 (sec)	2,000	2,120 (-6%)
Stitch.Efx 2.0 (sec)	831	647
ProShow Producer 5.0 (sec)	1,446	1,164
x264 HD 5.0 (fps)	21.1	20.3 (-4%)
Batman: Arkham City (fps)	76	133
3DMark 11	5,847	8,877

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

SPECIFICATIONS

Processor	Intel Core i7-4770K@4.6GHz
Mobo	Asus Gryphon Z87
RAM	8GB G.Skill DDR3/1866
Video Card	2x EVGA GeForce Titan
Sound Card	Onboard
Storage	2x 960GB Crucial M500 SSD in RAID 0
Optical	Panasonic UJ-265
Case/PSU	Custom / Silverstone ST1000P



Besides being heavy, the laptop is also shockingly tall at 2.4 inches.

AVADirect Clevo P570WM

It's got a tank's firepower... and weight

AVADIRECT'S CLEVO P570WM might look like a laptop, but make no mistake about it, you won't be using this on your lap. With a gargantuan carry weight of almost 20 pounds and a humongous chassis measuring 16.5x11.2x2.4-inches, this is the definition of desktop replacement. The reason it's so heavy and massive, besides requiring a pair of three-pound power bricks to take full advantage of its power, is that it houses an X79 chipset with a hexa-core Core i7-3970X and two GeForce GTX 680Ms graphics cards. When you add in its 32GB of RAM and two storage drives—including a 250GB SSD—it's easily the most well-spec'd notebook we've ever tested.

The Clevo's black chassis features a brushed-aluminum finish and a blue LED–backlit keyboard. Though these aesthetic touches are appreciated, it's hard for the Clevo to look sexy when it's so damned fat.

While we would have preferred an IPS panel for the 17.3-inch 1080p monitor, it does offer excellent viewing angles for a TN screen. We're not just being screen snobs here—we honestly think such a powerful laptop is likely to be used for workstation tasks, which almost mandates a color-accurate screen. Audio side, the Clevo's speakers are disappointing. They sound thin, lack bass, and aren't as loud as we would have liked.

We do, however, like the Clevo's keyboard, which is quiet and responsive. The trackpad is competent and supports multi-touch gestures, but we found these controls too jumpy and unpredictable.

As expected, the Clevo was able to obliterate our comparatively humble MSI GT60 zero-point in our performance tests. It held a 45 percent lead in our Stitch.Efx 2.0 benchmark, and even wider gains in the multithread-loving x264 HD test. Its least-impressive lead came in ProShow, which tops off at four cores. AVADirect's offering really came into its own in our GPU tests, blasting away our zero-point's single 670M by 240-plus percent in STALKER: CoP and 3DMark 11. The only area where the Clevo lost was in battery life, lasting 65 minutes while playing a movie, which isn't terrible, considering its power-hungry components.

In our experiential gameplay tests, we ran Borderlands 2 maxed out, with a frame rate in the mid-80s at 1080p. While the Clevo wasn't able to smoothly run Far Cry 3 on its highest Ultra settings, we did muster average frame rates in the 30s by turning down the settings to Very High and disabling AA.

The big downside to all these beefy components is that they generate a lot of heat. Even though the Clevo never got unbearably hot, its fans did get annoyingly loud. It sounds like you have a small server in your room, even when you're just surfing the web. It's loud enough that it can actually tarnish your movie-watching experience.

While the Clevo P570WM is by far the most powerful laptop we've reviewed so far, at nearly $5,000, it's also one of the most expensive. But its MSRP isn't the only high price you'll pay; with its low portability as a laptop and high fan noise, AVADirect's unique form factor makes some unfortunate compromises for the sake of absolute power. –JIMMY THANG

VERDICT 8

AVADirect Clevo P570WM

+ ABRAMS TANK Killer specs and ridiculous power.

− SHERIDAN TANK Huge; heavy; noisy; expensive.

$4,900, www.avadirect.com

SPECIFICATIONS

CPU	3.5GHz Intel Core i7-3970X
RAM	32GB DDR3/1600
Chipset	Intel X79
GPU	Two Nvidia GTX 650M in SLI
Display	17.3-inch, 1920x1080 TN display (glossy)
Storage	750GB HDD (7,200rpm), 250GB SSD
Optical Drive	Blu-ray combo drive
Connectivity	Ethernet, DVI, HDMI, 3x USB 3.0, 2x USB 2.0, audio in, headphone, mic, 2MP webcam, built-in Bluetooth, 802.11n, eSATA, DisplayPort, Mini USB, 9-in-1 card reader
Lap / Carry	13 lbs, 8.8oz/19 lbs, 14 oz

BENCHMARKS

	ZERO POINT	
Stitch.Efx 2.0 (sec)	1,092	752
ProShow Producer 5 (sec)	1,786	1,604
x264 HD 5.0	12.0	18.9
STALKER: CoP (fps)	32.8	127.5 (288.7%)
3DMark 11 Perf	2,979	10,327 (246.7%)
Battery Life (min)	187	65 (-65.2%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point notebook is an MSI GT60 with a 2.3GHz Intel Core i7-3610QM, 12GB DDR3/1600, two 500GB Seagate 7,200rpm hard drives, a GeForce GTX 670M, and Windows 7 64-bit. STALKER: CoP tested at 1920x1080 with Ultra settings, Tessellation, and contact hardening.

Toshiba Kirabook

The luxury lover's laptop

WHILE MUCH of the PC industry is hustling to bring lower-cost Ultrabooks to market, Toshiba is unabashedly raising the high end, complete with an all-new brand meant to ooze excellence. The first product to wear this proud badge is the 13.3-inch Kirabook. With its upmarket looks, über-high-res screen, and serious-for-its-size parts, this high-priced newcomer is gunning for no less than Apple's Retina display–boasting MacBook Pro.

Aesthetics are obviously central to the equation, and the Kirabook's got them, exuding elegance in everything from the subtly wedged profile that measures just 0.7 inches at its thickest, to the rounded rear corners of the chassis, to the brushed-metal finish, to the matte-black keyboard with backlighting. It's all packaged in a magnesium-alloy body that's both thinner and lighter than its MacBook Pro equivalent, but still feels sufficiently sturdy while being sure to draw approving looks.

One of the Kirabook's most visually distinct features, however, isn't evident until you power on and its 2560x1440 screen comes to life. That's the highest-res panel of any Windows-based ultraportable and just 160 pixels shy of the vaunted Retina display in the 13-inch MBP. At 221 pixels per inch (the MBP has 227ppi), the Kirabook's panel, which sits behind protective Corning Concore glass, looks lovely, with nice color and impressive detail. Besides being a boon to HD videos and pictures, the increased resolution gives multitaskers a welcome boost in real estate. Just be warned that when using the notebook's 10-point touchscreen (something the MBP doesn't have, incidentally), it can be tricky to accurately tap a given box, word, or menu item when working in the less touch-friendly desktop environment—a frustration we've encountered on even 1920x1080-res notebook touchscreens. Fortunately, the Kirabook's touchpad is capable. It's not quite as smooth as the MBP's touchpad (sadly, few Utlrabook touchpads are), and we did have to tweak the sensitivity some to keep the cursor from jumping randomly, but we were able to do real work on the Kirabook without resorting to a mouse.

The Kirabook sports a full-size HDMI-out port, and thankfully it's version 1.3, so it supports 2560x1600 resolution. The Kirabook lacks an Ethernet port, but has three USB 3.0 ports and an SD card slot. It does not support 802.11ac.

Component-side, the Kirabook packs some decent horsepower for its size, most notably a 2GHz Core i7-3537U, 8GB of DDR3/1600 RAM, and a 256GB SSD that hit near-500Gb/s sequential-read and -write speeds in CrystalDiskMark. The only benchmark where the Kirabook stumbled was in our Adobe CS3 tests, but that has less to do with the notebook's hardware than it does with the age of the benchmark, and likely incompatibilities with the full versions of Photoshop Elements and Premiere Elements that come bundled with the Kirabook.

Those programs plus two years of Norton Anti-Theft Security and a two-year warranty that includes 24/7 technical support contribute to the Kirabook's high asking price of two grand.

If you're into those extras and having the highest-res screen on an Ultrabook, the Kirabook's your ticket to living large.

–KATHERINE STEVENSON

VERDICT 9

Toshiba Kirabook

+ LUXURY Eye-popping screen; good looks and build; strong performance; bundled extras.

– LACKARY Expensive; value depends on interest in extras.

$2,000, www.toshiba.com

BENCHMARKS

	ZERO-POINT	
Premiere Pro CS3 (sec)	840	WNR
Photoshop CS3 (sec)	100	WNR
ProShow Producer (sec)	1,122	1,042
MainConcept (sec)	1,901	1,840
Quake III (fps)	358.2	429.3
Quake 4 (fps)	76.1	81.1
Battery Life (min)	221	232

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point ultraportable is an Intel reference Ultrabook with a 1.8GHz Intel Core i5-3427U, 4GB of DDR3/1600 RAM, integrated graphics, a 240GB SSD, and Windows 8.

SPECIFICATIONS

CPU	2GHz Core i7-3537U
RAM	8GB DDR3/1600 dual channel
Display	13.3-inch 2560x1440 IPS LCD
Storage	Toshiba 256GB SSD
Connectivity	HDMI, headphone/mic, 3x USB 3.0, media reader, 802.11n
Lap / Carry	2 lbs, 12.8 oz / 3 lbs, 6 oz



The Kirabook's Harmon Kardon speakers pack a nice punch for such a portable device.



Seagate's first SSD is packing the same NAND and controller as Corsair's line of Neutron GTX drives.

Seagate 600 SSD 480GB

The 800-pound storage gorilla finally steps into the ring

OVER THE PAST two years, we've witnessed the rise of the solid-state drive (SSD), and one of the most surprising aspects of this technology's ascension is that it's occurred without any involvement from the world's two largest storage companies: Western Digital and Seagate. Perhaps they thought it was just a fad, or that it was too expensive for the average consumer. Regardless, this month we are pumped to see the world's largest storage company, Seagate, wade into the solid-state arena with a competitively priced SSD dubbed the 600. Like other drives in the mid-tier price range, the 600 features a 3-year warranty and is offered in 120GB, 240GB, and 480GB capacities.

This is Seagate's consumer SSD—the company will also be offering a Pro version, but that drive is targeted at enterprise users only, instead of hardcore PC enthusiasts. The 600 SSD uses the same Link A Media Devices (LAMD) controller found in the Corsair Neutron series SSDs. But even though the two drives share controller technology, Seagate made it clear to us that the 600 series uses a controller that Seagate designed in-house, and that it was developed a while ago before Hynix purchased LAMD, so it's not the same as the technology found in Corsair's drives. The 600 also uses Seagate's custom firmware.

The drive we tested is 7mm in height, but Seagate tells us there will also be a 5mm version coming soon, which would be the thinnest 2.5-inch SSD we've ever seen. All of the 600 series drives use 19nm MLC NAND from Toshiba, which is hot off the conveyor belt, having just been released in March 2013. Corsair has also switched its entire line of Neutron GTX SSDs over to the 19nm Toshiba NAND, so it has some street cred in enthusiast circles.

In testing, we saw the Seagate drive perform well enough in sequential-read and -write tests to place it just one tick below the fastest SSDs available, and it's also faster than Corsair's Neutron despite using the same controller, so kudos to Seagate for a stellar first entry into the SSD game. Its random 4K read and write speeds were also totally decent, and we saw the drive hit over 80K IOPS in Iometer, and score the best time we've seen in our Sony Vegas test out of all these drives. Overall, the Seagate drive is very strong, and very well-balanced.

There's just one problem: It's too expensive. The Crucial M500 is less expensive than this drive and just as fast, and the 256GB Corsair Neutron GTX is also as fast but has a 5-year warranty for just $10 more. The 600 is a great SSD, but it doesn't differentiate from its peers in performance or price enough to warrant a higher verdict.
–JOSH NOREM

BENCHMARKS

	Seagate 600	Seagate 600	Corsair Neutron	Crucial M500	Samsung 840
Controller	LAMD	LAMD	LAMD	Marvell 9187	MDX
Capacity	480GB	240GB	240GB	480GB	500GB
CrystalDiskMark					
Avg. Sustained Read (MB/s)	514	**515**	454	480	464
Avg. Sustained Write (MB/s)	**465**	462	363	422	333
AS SSD					
4KB Read (IOPS)	6,826	6,585	6,684	6,388	**6,921**
4KB Write (IOPS)	15,568	16,020	16,963	**17,003**	15,955
ATTO					
64KB File Read (MB/s)	**520**	**526**	385	502	335
64KB File Write (MB/s)	465	465	379	422	**531**
Iometer					
4KB Random Write 32QD (IOPS)	80,861	**84,390**	80,466	83,354	70,654
PCMark Vantage x64	57,974	32,394	70,030	**71,619**	52,557
Sony Vegas Pro 9 Write (sec)	**316**	322	375	485	435

Best scores are bolded. All tests conducted on our hard drive test bench, which consists of a Gigabyte Z77X-UP4 motherboard, Intel Core i5-3470 3.2GHz CPU, 8GB of RAM, Intel 520 Series SSD, and a Cooler Master 450W power supply.

VERDICT 8

Seagate 600 SSD 480GB

+ SEAGATE Fast across the board; semi-affordable; looks swanky.

– WATERGATE 3-year warranty; wee bit too pricey; no software.

$420 (street), www.seagate.com

OCZ's "mainstream" SSD uses its very own in-house Barefoot 3 controller and 20nm MLC NAND flash.



OCZ Vertex 450 256GB SSD

A more affordable Vector has finally arrived

WE WERE ALWAYS big fans of OCZ's Barefoot 2–powered Vertex 4 SSDs. Heck, we even ran two of them in the almighty Dream Machine 2012. If that's not a stamp of approval, we don't know what is. But the SSD game moves quickly, and you have to keep up or you get left behind, so this month OCZ has put the Vertex 4 out to pasture and ushered in a new drive bearing the moniker Vertex 450. Unlike the Vertex 4, which ran a Marvell-based controller with custom OCZ firmware, this bad boy is juicing via OCZ's very own Barefoot 3 controller, which we first examined in the Kick Ass–caliber Vector SSD. The Vector is so fast that it currently sits atop the leaderboard of our SSD benchmarks, right next to the equally Kick Ass Samsung 840 Pro, and both drives are as good as it gets in the SSD world. But like Samsung, OCZ needs a drive to appeal to the common folk with a bit less cash in their PayPal accounts, so it's done what Samsung has done with its vanilla 840 drives and released this midrange SSD with a 3-year warranty to compete at a lower price point than the Vector. These are hotly contested waters, though, so the Vertex 450 has its work cut out for it.

At the heart of this drive is the renowned Barefoot 3 controller, though this is not the same animal you will find in a Vector. This version is called the M10; it has a slightly lower clock speed and the ability to work with the 20nm NAND flash instead of the Vector's 25nm IMFT MLC NAND. For what it's worth, the Vertex 4 also used 25nm NAND, and the move to smaller-process flash helps reduce costs and improve capacities, though endurance is affected. Still, OCZ says the drive is good for 20GB every day for three years, which is considered a "heavy" workload. The Barefoot 3 controller also supports 256-bit AES encryption and has Trim support, and promises high performance without resorting to data compression or needing to reserve some space for over-provisioning either, so you get the drive's full capacity (238GB after formatting). It's available in the usual sizes: 128GB, 256GB, and 512GB.

In our testing, we found the midrange Vertex 450 to be a totally adequate performer, as it hummed along right at the magical 500MB/s mark for most of its sequential-read speed tests. This is pretty much standard with modern SSDs; the 450 is right where it needs to be in terms of competitive performance. Its 4K random-write performance was middling overall, but placed dead last in this group. It's "real world" performance, though, as measured by PCMark Vantage was top-of-the-list, with it smokin' the Samsung 840 and Seagate 600 drives.

Overall, this is a great drive and is fast across the board. But like the Seagate 600 (opposite page), it's too expensive. For this price, you can get an SSD with a 5-year warranty and more performance, like a Samsung 840 Pro. –JOSH NOREM

BENCHMARKS

	OCZ Vertex 450	Crucial M500	Samsung 840	Seagate 600
Controller	Barefoot 3	Marvell 9187	MDX	LAMD
Capacity	256GB	480GB	500GB	240GB
CrystalDiskMark				
Avg. Sustained Read (MB/s)	474	480	464	**515**
Avg. Sustained Write (MB/s)	**493**	422	333	462
AS SSD				
4KB Read (IOPS)	5,595	6,388	**6,921**	6,585
4KB Write (IOPS)	**17,251**	17,003	15,955	16,020
ATTO				
64KB File Read (MB/s)	501	502	335	**526**
64KB File Write (MB/s, 4QD)	516	422	**531**	465
Iometer				
4KB Random Write 32QD (IOPS)	67,285	83,354	70,654	**84,390**
PCMark Vantage x64	**72,572**	71,619	52,557	58,145
Sony Vegas Pro 9 Write (sec)	**272**	485	327	322

Best scores are bolded. All tests conducted on our hard drive test bench, which consists of a Gigabyte Z77X-UP4 motherboard, Intel Core i5-3470 3.2GHz CPU, 8GB of RAM, Intel 520 Series SSD, and a Cooler Master 450W power supply.

VERDICT 8

OCZ Vertex 450 256GB SSD

+ BARE BOTTOM More than enough speed; very solid build; OCZ firmware tools.

− BAREFOOT Too expensive; 3-year warranty.

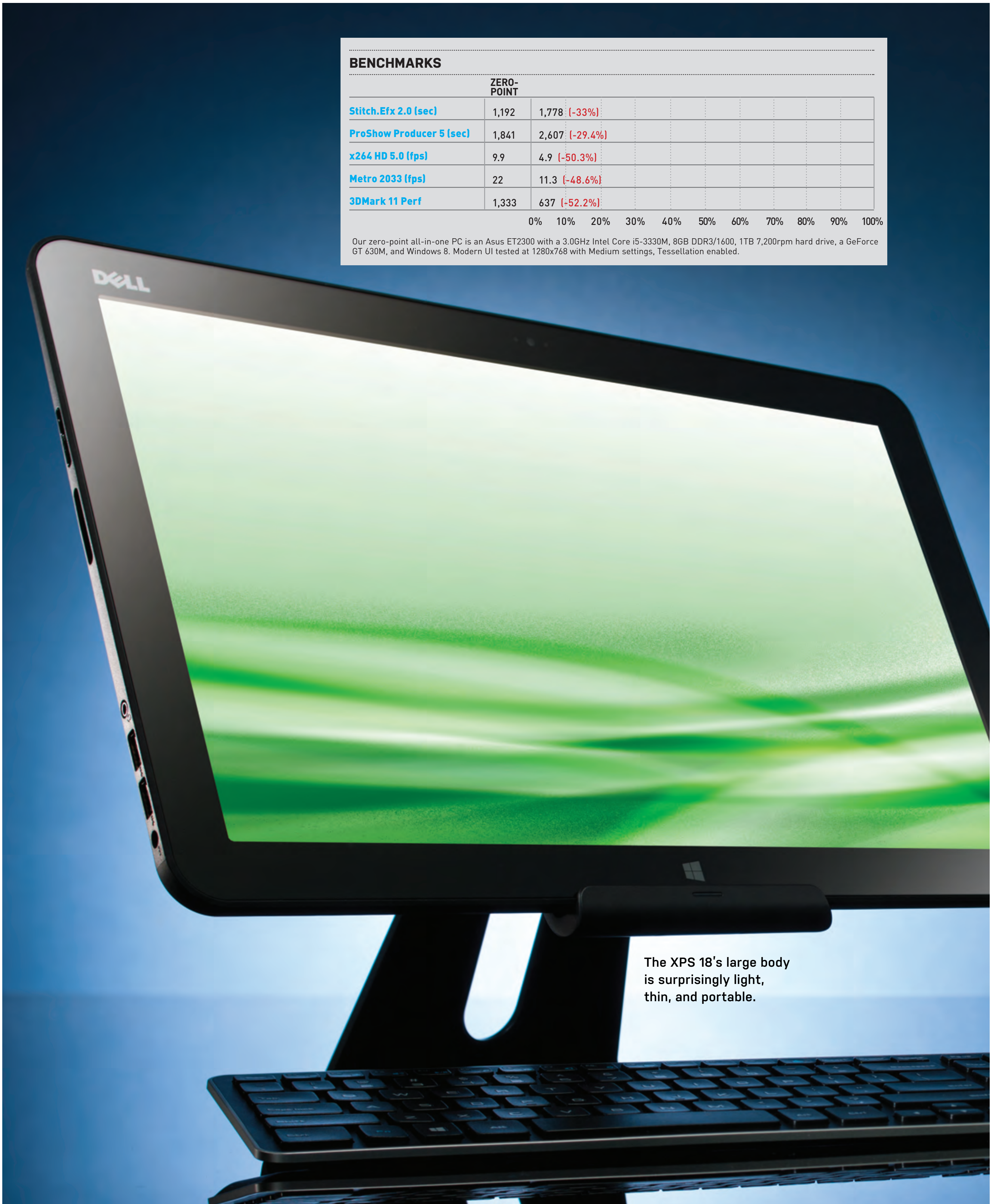
$235, www.ocz.com

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	1,192	1,778 (-33%)
ProShow Producer 5 (sec)	1,841	2,607 (-29.4%)
x264 HD 5.0 (fps)	9.9	4.9 (-50.3%)
Metro 2033 (fps)	22	11.3 (-48.6%)
3DMark 11 Perf	1,333	637 (-52.2%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point all-in-one PC is an Asus ET2300 with a 3.0GHz Intel Core i5-3330M, 8GB DDR3/1600, 1TB 7,200rpm hard drive, a GeForce GT 630M, and Windows 8. Modern UI tested at 1280x768 with Medium settings, Tessellation enabled.



The XPS 18's large body is surprisingly light, thin, and portable.

Dell XPS 18

When form offers function

ON PAPER, the Dell XPS 18 all-in-one/tablet hybrid shouldn't work, with its massive 18.4-inch screen potentially destroying any possibility of portability. And yet, it works well.

While its five-pound chassis isn't necessarily light, it weighs less than many gaming laptops and is quite svelte for its class, measuring 11x18.25x.69 inches, and is half the weight of Sony's similar Tap 20 AiO/tablet hybrid. Although it's more than double the weight of the Razer Edge, a 10-inch tablet we criticized for being too heavy, we never felt like we had to lift the XPS 18, as it could rest on our laps comfortably. And because its screen is so large, our necks never had to strain to look down. Flip-out stands on either end of the XPS 18 allow it to be used propped up on a desk in landscape mode—with a higher angle suitable for sitting, and a lower angle for using the device from a standing position. The XPS 18 is really made to be moved from desk to desk, but it's so elegantly designed that you could use it as a giant tablet, provided you're OK with the strange looks you'll surely get in public (and yes, we know this firsthand).

Of course, the thinness that makes it viable as a tablet also leads to some compromises as an AiO, especially when it comes to ports. The XPS 18 has just two USB 3.0 ports and an SD card slot. This means no HDMI out or in, no Ethernet port, no DVD drive. Furthermore, although an 18.4-inch screen is huge for a tablet, it's quite modest for an AiO.

Luckily, the screen itself is gorgeous. The XPS 18 features a 1920x1080, 10-point capacitive-touch IPS display with great viewing angles and vibrant colors. Although it features a glossy surface, it's not overly reflective like other AiOs we've reviewed.

Most tablets feature speakers on the back directing audio away from you, but Dell's offering has them side-mounted, which contributes to the XPS 18's clear sound—the volume capabilities, however, might disappoint headbangers hoping to blast the audio to 11.

Our unit came with a stand that raises the AiO about three inches and allows you to tilt the screen roughly 40 degrees. Supplementing it were Dell's Tangerine wireless keyboard and mouse. While the peripherals' black-and-gray aesthetic doesn't quite match the XPS 18's completely black design, both accessories are solid in use. The 15-inch keyboard has a nice weight to it and doesn't feel like a cheap add-on, and the mouse features a scroll wheel that can be shifted left to right, which allows users to navigate horizontally through the Windows Modern UI.

Unfortunately, the XPS 18's specs aren't anything to write home about. Besides its 8GB of RAM, its parts are relatively humble: a 1.8GHz Core i5-3337U CPU that can Turbo up to 2.7GHz and a 500GB hard drive with a 32GB caching SSD that helps access times in frequently used programs. But its lack of a video card is its biggest flaw.

Because of this omission, the XPS 18 got blasted by our GeForce GT 630M–equipped Asus ET2300 zero-point by roughly 50 percent in both our STALKER: CoP and Metro 2033 tests. This once again proves that integrated graphics can't match even the weakest graphics cards—yet. While you certainly won't be playing Crysis 3 on max here, we were able to get frame rates in the mid-50s on Valve's popular Dota 2 Source Engine game on the lowest settings at 1080p resolution. The XPS 18's dual-core CPU also could not rival our ZP's quad-core Core i5-3330 processor, losing by similarly dramatic margins in our multithread-loving x264 benchmark. It fared a little better in our other CPU tests, but nothing worth mentioning. Booting the system took 21 seconds, which is about right for a computer with a hard drive and caching SSD combo. Battery-side, the XPS 18 lasted three hours and 22 minutes watching a high-def movie ripped from disc. While this isn't great for a traditional tablet, it's good for a laptop, and unprecedented for any AiO we've tested since, well, most don't have batteries.

At $1,350, what you're paying for here is the unique form factor and dual use cases. What it lacks in ports and power, the XPS 18 makes up for with its excellent large screen, relative portability, and thoughtful design. –**JIMMY THANG**



Dell XPS 18

VERDICT **8**

+ DELL Large, lovely screen; shockingly portable; good accessories.

– HELL Integrated graphics; lack of ports.

$1,350, www.dell.com

SPECIFICATIONS

CPU	1.8GHz Intel Core i5-3337U
GPU	Intel HD 4000
RAM	8GB DDR3/1333
Storage	500GB (5,400rpm) HDD, 32MB cache SSD
Optical	N/A
Display	18.4-inch IPS display, 1920x1080 (10-point capacitive touchscreen)



One 12cm and one 13.5cm fan push air through this beast.

Be Quiet Dark Rock Pro 2 CPU Cooler

60 percent of the time, it works every time

ALTHOUGH THE gearhead legions appear to be moving in droves to liquid cooling, there's still plenty of value in large air-coolers. You don't need to remap your case airflow to accommodate them, and there's no chance of them peeing all over the inside of your computer someday. Depending on your setup, however, even a nice air cooler can meet its match.

The latest challenger is Be Quiet, a German company that until now has been selling its coolers and case fans mostly in Europe. We Americans had to shop at specialty websites and use secret handshakes to get our grubby, freedom-loving hands on one. The Dark Rock Pro 2, however, is available now on NCIX.com (and Be Quiet tells us it'll be supplying stuff to Newegg before long). What's the appeal? Well, the DRP2 is all about low noise, and it looks pretty slick. Its 12cm and 13.5cm fans will max out at about 1,425rpm; for reference, a Cooler Master Hyper 212 Evo's 12cm fan will crank up to 2,000rpm.

We experimented with the DRP2 on an LGA1155 motherboard last month, in our Build It article. It performed fine with an Intel Core i7-3770K, a quad-core CPU that we overclocked to 4GHz. And it wasn't too difficult to install, despite its size. Were this our test platform, then the DRP2 would probably come away looking quite impressive.

However, our test rig uses a hexa-core Core i7-3960X overclocked to 4.1GHz. It has nearly twice the TDP of the 3770K and can make a lot of heat when pushed hard. While the DRP2 performed at least as well as a 212 Evo when the CPU load was light, it struggled to keep up when we engaged Intel's thermal testing tool, coming in several degrees higher than the Evo. Granted, the Evo will produce substantially more noise at this point (a 2,000rpm fan speed, versus 1,400rpm). But the DRP2 currently costs about three times as much an Evo, which we find difficult to justify when dealing with a beefy CPU like this one. We also tested the DRP2 against the similarly designed and quiet Phanteks TC14PE, which came in about 5 degrees Celsius lower and currently costs less, too (Be Quiet says it expects prices of the DRP2 to drop as more retailers carry it).

Also, a word on installation. The Core i7-3960X uses Intel's LGA2011 socket, which has a non-removable backplate. This alters the way in which coolers are installed. In the DRP2's case, this was a change for the worse. It attaches to its bracket by threading nuts onto some bolts. But the nuts are almost completely obscured by the sheer size of the cooler. We actually had to pull the motherboard out of the case and remove the RAM and video card to get enough clearance to install the nuts. Meanwhile, the 212 Evo just uses a 2011-specific bracket whose fasteners are reachable with a standard screwdriver. The TC14PE is manageable if you have a screwdriver with a long shaft.

The Dark Rock Pro 2 performs respectably and quietly on any LGA1155 processor, but the Phanteks TC14PE remains the overall champ for lower-noise air coolers. –TOM MCNAMARA

BENCHMARKS

	Dark Rock Pro 2 Quiet Mode	Dark Rock Pro 2 Performance Mode	Phanteks TC14PE Quiet Mode	Phanteks TC14PE Performance Mode	212 Evo Performance Mode
Ambient Air	20.2	20.5	20.0	19.9	20.0
Idle Temperature	33.0	29.4	32.0	**28.5**	30.5
Load Temperature	75.3	71.8	70.3	68.6	**67.3**
Load - Ambient	55.1	51.3	50.3	48.7	**47.3**

Best scores are bolded. All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.1GHz, on an Asus Rampage IV Extreme motherboard, in a Corsair 900D with stock fans set to Standard.

VERDICT 7

Be Quiet Dark Rock Pro 2

+ **RON BURGUNDY** Good performance for LGA1155; sleek looks.

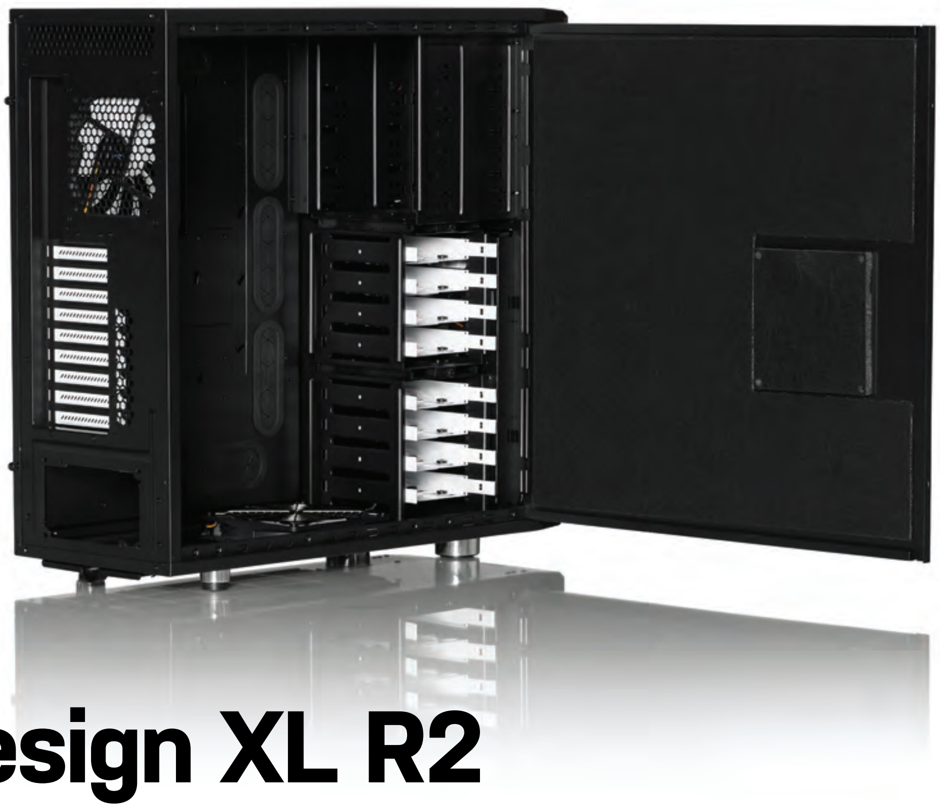
– **WES MANTOOTH** Kludgy install for LGA2011; underwhelming price/performance ratio.

$100 (street), www.bequiet.com

SPECIFICATIONS

Heatsink Dimensions (H x D x W)	6.53 x 5.79 x 5.43 inches
Weight	2.76 lbs
Stock Fans	1x 12cm PWM, 1x 13.5cm PWM
Socket Support	LGA1155/1156/1366/2011; AM2/AM2+/AM3/AM3+/FM1/FM2
Additional Fan Support	None

The XL R2 distinguishes itself from the nearly identical Define R4 by supporting larger motherboards.



Fractal Design XL R2

Bigger, bulkier, and slightly better

FRACTAL DESIGN is a big fan of small, subtle modifications within its various lines of computer cases, or so it seems. At first glance, you might assume we are simply blowing some dust off the ol' Fractal Design Define R4 and giving it a re-review. And we wouldn't blame you for thinking so—the two cases look nearly identical.

As the "XL" in its name implies, the Define XL R2 is a taller, slightly fatter version of Fractal's Define R4 chassis. The "embiggening" allows the XL R2 to support E-ATX and XL-ATX motherboards, for those of you looking to stuff your system full of video cards. At just over 1.8 feet tall, the XL R2 doesn't feel like that much of a monster underneath a typical desk. Its perfectly rectangular design helps keep its overall footprint smaller than cases with curvier panel designs.

Fractal covers nearly every bit of the XL R2's surface with sound-dampening foam of varying thickness. It works to keep the noise down, but not as well as the system's included three-fan controller, which we're glad Fractal still throws into the mix. Slapping the case's three included 14cm fans onto a medium speed setting, combined with the sound-dampening foam, does much to quiet this system to a dull hum. However, all of the fans and test system components spinning full-bore does manage to get a bit noisy.

We're pleased to see that Fractal has opted to double the amount of available 5.25-inch bays in the XL R2 versus the Define R4, which gives enthusiasts a bit more room to play with. We still wish that they were screwless, but we appreciate the extra space. The XL R2's eight drive bays are split into two drive cages of four trays each, and both are moveable (or removable) to make room for bulkier front-panel radiators—or better still, unhampered airflow.

The case's considerable cable management capabilities continue to impress us. Seven huge, rubberized holes on the motherboard tray deliver plenty of space to string cables between the tray's rear and the case's (heavy) side panel, which includes connections for the system's two front-mounted USB 2.0 and USB 3.0 ports. The cables for the system's front-panel connectors (power light and power button only) could stand to be a bit longer.

We only had two big qualms when building a system in this chassis. First, we would have much preferred to have the case's motherboard standoffs already built into the tray (or a guide peg for helping us to align the motherboard itself). Fractal Design also does something weird with the power supply installation, in that it opts to stick two triangular pieces of rubber on the bottom of the case that the PSU should, in theory, be able to rest on.

In practice, our power supply knocked these rubber pegs completely off the case's bottom. Even when they stayed put, we still had a bit of a fuss screwing our PSU into the chassis. We would have preferred some mechanism that keeps the PSU level on all four of its sides.

Fractal Define's XL R2 is a wee pricier than the Define R4; you're paying a surcharge for the slight reworking and roomier interior. Minus the omission of the Define R4's two motherboard tray SSD mounts, the XL R2 is a pleasant (albeit minor) upgrade to Fractal Design's smaller chassis. –DAVID MURPHY

VERDICT 8

Fractal Design XL R2

+ **R2-D2** Built-in fan controller; ample 5.25- and 3.5-inch bays; excellent cable management; sound-dampening foam.

- **R5-D4** Not screwless; motherboard standoffs require installation; uncooperative PSU rubber mounts; no SSD mounts on motherboard tray.

$140, www.fractal-design.com

Monaco: What's Yours Is Mine

Steal all the things

MONACO: WHAT'S YOURS IS MINE could really just be called Monaco: What You Make of It.

It's not that Monaco's gameplay is overly complicated. At its core, this is one of the more simplified crime-themed titles you'll likely ever get your hands on. You need to master all of three buttons or so in this top-down, pixilated "heist game" that developer Pocketwatch Game has released via Valve's Steam platform.

What makes Monaco *complex*—yes, there's a difference—is that you're given free rein to complete the game's various heist-themed missions just about any way you want. And that's accentuated by the game's (eventual) offering of eight different character classes for the picking. Feel like knocking out some guards to break into a bank? Pick "The Cleaner." Want your little character to do his or her best Mystique impression? Disguise yourself and walk around the game's levels as "The Gentleman."

Monaco isn't Rainbow Six. In many ways, it's difficult to pre-plan for some of the twists and turns the game's AI throws your way. Sneaking your way through a level works wonders until a random, nearby phone starts ringing and guards start a-rushing to answer it. The game's unique "fog of war"–like effect perfectly renders exactly what you can and cannot see within a level based on where you happen to be hiding. You can even stop and listen for nearby guards; the game highlights their walking paths with footsteps directly on your map.

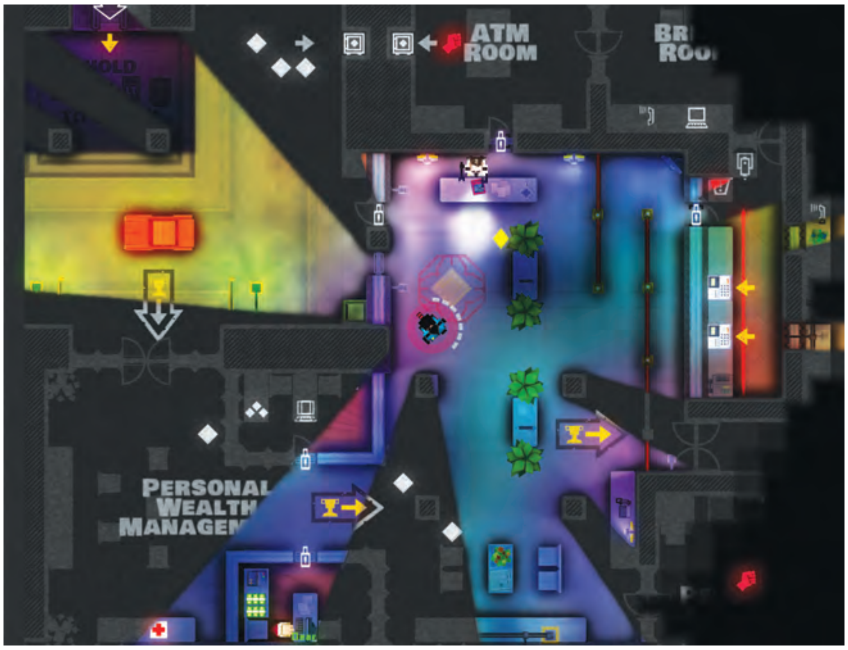
Invariably, though, something will hit the fan in Monaco: Your planning will go awry, you'll sneak into a room from a tight corridor only to find a guard or civilian staring directly at you, or perhaps you'll just get tired of stealth and opt for a little run-and-gun burglary. And that's where Monaco truly shines, especially in the game's more frantic multiplayer mode.

You and three of your fellow cronies—found over the Internet, your local LAN, or via hot-seat gaming using a single monitor with multiple keyboards/controllers/etc.—all pick a character class and work your way through the level using voice chat (we recommend) or text (you're crazy). The classes and characters can complement each other. For example, when one of you picks The Lookout, all can then see the footsteps of nearby guards in adjoining rooms.

And, naturally, when one of you screws the pooch and raises alarms—which in turn, raises the franticness of the game's lovely 1920s-themed piano score—it's a mad dash for guns, exits, hiding places… you name it. Hello, survival-at-any-costs.

While we generally enjoyed our criminal career, we think that Monaco could be improved a bit by more directly tying use of the game's characters to its levels. We liked being able to just stick to our favorites to beat the game's single-player campaign, but Pocketwatch could better incentivize the use of underused or ill-fitting characters via achievements or other unlockables.

We would also love to see a bit more variety in the missions themselves: Perhaps a more spy-themed Monaco spinoff could make us feel like the Tom Cruise we've always wanted to be, instead of just a mere cat burglar who occasionally punches through walls while collecting hundreds of items scattered around a map (to unlock additional levels). Monaco's multiplayer is absurdly fun; its single-player campaign feels like someone stole the wind from the game's sails just a wee bit.
–DAVID MURPHY



We love Monaco's line-of-sight mechanism, even as much as it ruins our stellar planning.

VERDICT 8

Monaco: What's Yours Is Mine

+ **JASON BOURNE** Hilariously fun when planning goes awry; plenty of characters to pick from; intriguing gameplay mechanics; great multiplayer support.

– **INSPECTOR CLOUSEAU** Single-player can get tedious; unlockable system seems slightly out-of-place (and a bit aggravating); no real impetus to use less-desirable characters.

$15, pocketwatchgames.com, ESRB: T



Just your usual Moscow traffic congestion.

Metro: Last Light

You won't eat fresh in this subway, but it's still pretty tasty

WHEN METRO 2033 came out about three years ago, it didn't make much of a splash at first. The name and cover art didn't explain much, and its publisher did not have a Call of Duty–size ad budget. By the time we understood that it was set in a post-apocalyptic Moscow where everyone had to live underground (to avoid radiation sickness and hideously mutated beasties), Metro 2033's moment had passed. However, probably thanks to aggressive and frequent discounts, it gained enough of a following to bring us a sequel.

Metro: Last Light is a direct continuation, picking up right where 2033 left off: The main character Artyom has discovered an enormous underground complex called D6, presumably made by the government as the ultimate fallout shelter, stocked with enough supplies to sustain everyone for years and years. Naturally, some people want to control this supply now. And naturally, they are not very nice. Artyom must figure out how to deal with that, while also wrestling with killing off the Dark Ones, a group of mysterious humanoids whom he perceived as a threat to humanity in the first game. But the theme of Last Light is that humanity's greatest enemy is usually itself.

If this sounds like heady stuff, there is a lot of straightforward stealthy action, as well. The game's achievements even reward you for non-lethal approaches (at least more so than killing everyone). You can approach patrols and guards with a variety of weapons and tactics, and your opponents are somewhat varied, too. They'll occasionally lob a grenade at you to flush you out, notice bodies and call for help, turn lights back on, activate headlamps and laser sights to hunt you down, and even call on elite troops for backup. However, human enemies do tend to wander alone into the darkness a lot, and they're not as alarmed as they should be when the power suddenly goes out.

And, of course, there are the mutants. Neither 2033 nor Last Light ever explain how these creatures evolved so quickly. It would be easier to believe that they were somehow transported from a different planet or dimension. That would create some story issues, but it's arguably better than pretty much ignoring how evolution works. That said, the muties present some engaging challenges, because they take a lot of punishment, move rapidly, and behave unpredictably. Sometimes they'll ignore you if you don't make much noise, and other times they



Mutants are not the only thing standing in your way this time.



This game can look pretty slick, if you have the horsepower.

will converge on you regardless.

In either scenario, Last Light does not have many difficulty spikes, which plagued the first game. On normal difficulty, an experienced FPS gamer should usually die only when they make a mistake, rather than because they are simply overwhelmed. Speaking of difficulty, the challenging Ranger Mode from 2033 is available at launch this time; it removes onscreen indicators, makes resources less plentiful, and will cause you to die after taking a few hits.

Officially, you can only get it if you either pre-ordered the "Limited Edition" or paid $5 to unlock the mode *after* launch. But we found copies of this version available at Amazon and Best Buy after launch, for the same price as the base game. The publisher said that "retailers" put pressure on them to issue pre-order DLC, but GameStop appears to be the only one in North America that stopped offering the Limited Edition after the game's release. We guess the other guys didn't get that memo.

The more common choice is to include some weapons and currency as pre-order DLC. Last Light's Ranger package does that as well, but it's not really needed. The base game has a variety of guns, customizations, ammo, and money. "Military-grade" ammo is still the coin of the realm, but it and everything else is a lot more plentiful than in 2033. The availability of weapons and ammo is not noticeably different from a standard shooter, despite the post-apocalyptic "scavenger" setting; the lack of scarcity sometimes breaks immersion. You need to use a gas mask to breathe on the surface, but we never wanted for oxygen canisters, undercutting the tension. They were strewn everywhere, as were spare masks with unused canisters pre-attached. Experienced FPS gamers should probably go straight to the game's built-in "Hardcore" difficulty, or even Ranger Mode if available.

Although the supplies issue is kind of ugly, the visuals are not. Metro: Last Light is an undeniably pretty game, even in its depiction of a dead city and decaying train system underneath. (Moscow's station architecture is actually quite beautiful in real life, making the contrast especially stark.) This beauty is not without cost. The game is arguably more demanding than Crysis 3; Deep Silver recommends a GeForce GTX 690 or Titan for an "optimum" experience (the game is branded by Nvidia and currently bundled with the GTX 660 and above), a quad-core CPU, and 8GB of system RAM.

By default, the game uses an antialiasing method called FXAA. You can't disable it, and its presence is not announced, but its performance impact is fairly minor. You can enable super-sample antialiasing on top of it (which generates an ultra-high-res frame and squishes it to fit your display resolution), but the impact may kill your frame rate. The highest level of tessellation (a technique to round off blocky objects) may also punish your system. There is also no option or even a hack to adjust the field of view, which is set to a relatively narrow 70 degrees; this is known to cause motion sickness in some people.

Though Metro: Last Light is fundamentally a shooting gallery, it also knows how to pace itself and tell a story. You can go through tense stretches on the surface, encountering little more than the howling wind and spooky shadows, or listen to extensive conversations between Metro residents. The plot doesn't always make sense, but there's a certain "just go with it" mysticism that starts to click toward the end. Sometimes things are ambiguous, and that's OK. It pays to stick with Last Light and just see where it leads you. Were this an open-world environment, we could see ourselves spending a lot of time here, bloodthirsty mutants and all. –TOM MCNAMARA

VERDICT 8

Metro: Last Light

+ **MAD MAX** Densely packed environment and narrative; entertaining combat; high-caliber visuals.

– **HOLOCAUST 2000** AI is occasionally dumb; curiously abundant resources; DLC confusion.

$50, www.enterthemetro.com, ESRB: M

LAB NOTES

JOSH NOREM **SENIOR EDITOR**



Nvidia Strikes Back

New cards signal that the GPU conflict is escalating

COVERING GPUS is like being in the mafia—just when I think there won't be any new cards for a while, the phone rings and it's AMD or Nvidia on the line, and they want to have a sit-down. This month it was Nvidia's turn, but as you read this, AMD is probably staging a conference call, so hopefully I'll have some new AMD hardware to cover next month. Since we already know what the upper echelon of Nvidia's lineup looks like for 2013, it'll be very interesting to see how AMD responds. Since 2013 is the year of the 28nm refresh for AMD and Nvidia, both are turning to higher clock speeds with existing silicon to create new models, but the question is whether or not AMD will be able to get away with it on the already-hot Tahiti core. I guess we'll find out soon enough.





Tom McNamara
Associate Editor

I've enjoyed messing around with these new Nvidia cards. The GeForce GTX 780 runs quieter than the Titan, even when overclocked to within spitting distance of it, and the GTX 770 comes in at $400 while delivering GTX 680 performance. I'd like to see a "770 Ti" somewhere in between, though.



Katherine Stevenson
Editor-in-Chief

While this month's Haswell feature gives us a glimpse of the chip's desktop capabilities, I'm more anxious to see how it pans out in Ultrabooks. After all, power savings and integrated graphics are its marquee features. I think a Head to Head between a Haswell and an Ivy Bridge ultraportable, with otherwise identical parts, is in order.



Chris Zele
Intern-in-Chief

With Nvidia launching its new GeForce GTX 780 and 770 cards, it looks like the green team has a big head start on the GPU war. I'm curious to see how AMD does with its upcoming 8000-series equivalents. Team red is definitely the underdog right now and I can't help but root for it, so that Nvidia doesn't dominate the market and overinflate GPU prices.



Richard Koscher
Art Director

What Gordon Mah Ung would call a classic case of being "back in the Matrix" is what I call a case of "at least I tried." Four months ago, I traded my iPhone for an HTC EVO 3D, but I'm going back. I just find the iPhone 5 faster, easier, and more user friendly. Sorry, I tried. (Gordon: True. It's like the time I used an iPhone 3GS with iOS 5 and said, "At least I tried.")

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> In Defense of Kool-Aid
> DIY All-in-One
> Moving to an SSD

Oh, Yeah!

What has gotten into Microsoft? Do they not realize that their users are not the Kool-Aid drinking fanatics that use Apple products? We are real users who want hardware that works the way we want it to work. When Windows 8 was in beta, the testers told Microsoft that the GUI was a joke. They were ignored. When sales were abysmal, Microsoft blamed the hardware manufacturers instead of listening to the users. When every review said the new GUI was horrible and only an idiot would think that putting a tablet GUI on a desktop was a good idea, Microsoft ignored them. And now, when the fans have expressed concern that the new Xbox will require an always-on Internet connection, Microsoft's response is, "Deal with it."

Windows 8 was just what Linux needs to succeed. And the new Xbox looks to be just the thing Ouya needs to succeed. Microsoft, on the other hand, appears to be doing everything it can to go out of business.

—Chuck Hewitt

DEPUTY EDITOR GORDON MAH UNG RESPONDS: I am going to say that it's completely unfair to trash a brand based on bias and misrepresentation. Not only is your attack mean spirited, it's also likely to spread misinformation that does nothing but hurt a completely innocent corporation.

I speak, of course, about Kool-Aid, which has not been at the center of any mass cult suicides that I know of. So please, dude, proper nomenclature: "PC users are not *Flavor-Aid* drinkers." As far as Metro/Modern goes, yeah, it's pretty far from optimal on a non-touch desktop or laptop, but it's also pretty easy to ignore most of the time.

Making Friends, One Fix at a Time

Your mag has been totally worth its weight in gold, and the latest example of that was your advice on how to fix the blue screen of death after enabling AHCI in the BIOS ("Fix It!" July 2013).

I have an Asus P6X58D motherboard and just got the Samsung SSD 840 Pro (256GB), and while the SSD worked and booted OK in IDE Mode, I could not get Windows 7 Professional to reach the desktop when I changed over to ACHI Mode in the BIOS—until I saw your solution involving a minor tweak of the Windows registry.

I recently did a two-year extension on my subscription and I'm glad I did! Thanks, guys! You really are the phreakin' *best*!

—Rod

DIY AIO Q&A

I truly believe that with Windows 8, it's time to really dig in to building my own kick-ass all-in-one touchscreen PC. I've been holding off, thinking I would get some good ideas on parts to use for my AiO from my friends at *Maximum PC*. Any chance you can do a how-to-build-a-touchscreen for the kick-ass and for the budget? I got a brand-new kitchen, and this seems like the perfect place for a touchscreen AiO.

—Phil

ASSOCIATE EDITOR TOM MCNAMARA RESPONDS: There are actually a number of bare-bones AiO touchscreens available right now, mainly from MSI and Shuttle. Amazon and AVADirect offer a variety to choose from. They come with a Mini-ITX motherboard, and you supply the CPU, the RAM (SO-DIMM sticks like you see in laptops), and the storage devices. They can take a 3.5-inch hard drive, but you usually need the "slim" version of an optical drive, assuming that a 5.25-inch bay is available. You may see some bare-bones AiOs that use Intel's new LGA1150 socket and "Haswell" CPUs by the time you read this. If not, LGA1155 is a good substitute. We don't recommend the ones that use the original Atom CPU.

Since these devices are designed to have a slim profile, you won't be able to fit a standard CPU cooler, or any video card. But the HD 4600 graphics built into Haswell should be fine for light gaming and HD videos. We've found it about twice as powerful as the IG from the older Ivy Bridge generation.

AMD Wuz Robbed

In your Budget Build story (June 2013), the AM3+ build was the only one that someone might actually build to keep, so it should've won. The FM2 build was all wrong, and no one would use that inadequate PSU or such a weak CPU for anything but a browser box or maybe an HTPC. The LGA1155 build

↘ submit your questions to: comments@maximumpc.com

used a generic power supply that no one in their right mind would plan on using. These two were built to win benchmarks. In a future matchup there should be significant weight given to common-sense building.

—**Walt Huber**

DEPUTY EDITOR GORDON MAH UNG RESPONDS: Believe it or not, Walt, but I was secretly rooting for the AMD machine, too. I think that AM3+ offers just the right performance/price ratio to outclass FM2 as well as LGA1155. But my task in that story wasn't to push for the other sockets, but to try to beat them, because this was a competition. Competition makes you better, and frankly, if I had built a nicely balanced Core i3 box with a good PSU and case, no one would care. I was out to prove that you could cost-cut an Intel-based box to make it competitive, and indeed better, than an AM3+ box.

"Better" is subjective, of course, but I think a lot of people would indeed give up a nicer case and big-name PSU if they could cut their application launch times with an SSD and be able to burn or read an optical disc on occasion.

I agree that performance was a factor in which rig won, but it's something that everyone wants. Entire websites are built around GPU vs. GPU and CPU vs. CPU, since these are performance-relevant parts. And to be fair to Rosewill, this isn't a Corsair, Antec, or Silverstone PSU, but it's from a company that has a presence in the United States and warranty support in English. It's not truly a no-name, it's just not a big name.

I'm also going to point out one of the fallacies of using "common sense" as a defense. Common sense doesn't actually mean anything, except to convey that everyone agrees with an opinion that's clearly not true.

Upgrading an OS and SSD at the Same Time

I really enjoyed the article on "Everything You Wanted to Know about SSDs..." (June 2013), but it didn't answer one important question for me: Is it possible to install an SSD in an existing system and copy Windows 8 over to the new SSD? I would like to give my aging PC a storage upgrade and have an upgrade version of Windows 8, but would rather not have to reinstall Windows and all the software.

—**Steve Ruegsegger**

SENIOR EDITOR JOSH NOREM RESPONDS: It would certainly be nice if we could just copy an OS to a different volume in our system, but that's not how Windows works, Steve. When it's installed to a hard drive, it buries its roots deep into that volume, then snakes its tentacles around every program that's installed, too. And since most of those files are in use by the operating system when the PC is running, you can't copy them to another volume even if you want to. However, it is possible to clone your drive's contents to another drive in a pre-boot environment where the files are free to be copied. You just need drive cloning software like Acronis True Image (www.acronis.com); Corsair even makes a tool to do this, so check into that if you have a Corsair drive. In your situation, our advice is thus: Back up all your data, install the Windows 8 upgrade as a clean install (save nothing, in other words), then once you have your new OS on your old hard drive, clone its contents to your new SSD. Then reinstall your programs and copy your data over from the backup source and you'll be in business. ⏻

[NOW ONLINE]

FANIMECON 2013 COSPLAY GALLERY

While FanimeCon is well known for its anime-inspired roots, this year's event showcased some of the most kick-ass examples of PC gaming cosplay we've ever seen. You couldn't walk for more than five minutes without seeing awesome Team Fortress 2 and League of Legends getups. You can check out our extensive 60-picture gallery here: http://bit.ly/133XdqM.



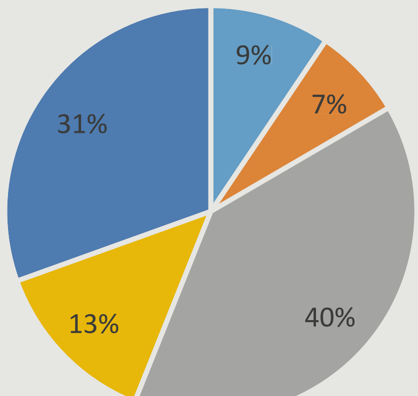
Facebook Polls

What Do You Call a 'PC Hardware Expert'?

In honor of this month's cover feature, we asked our Facebook fans what words they use to describe a "hardware expert." The answers were predictably entertaining.

Ed Cardenas: Keeper of the static bag, holder of the voided warranty
Jacob Skidmore: Technomancer
Cory Gott: Socket Jockey
Geremiah Benge: Silicone Savant
David Romeyn: The PC Whisperer
Ewin Sanchez: Thermal Grease Monkey
Dmnklr Modz: Connoisseur of Components
Billy Smith: PC Jedi
Mike Korkowski: PC God
David Gonzalez: The Dude
Bruce Taylor: Miracle Worker
Darryl Cooke: Moderately Deranged
Jason Rasmussen: Gordon Mah Ung
Wayne Johnson: Single

Will You Upgrade to a GTX 780 or GTX 770 GPU?



- Yes, the GTX 780
- Yes, the GTX 770
- Nope, too expensive
- Can't, love AMD too much
- Nope, current setup is fine

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THE BUILDS



BUDGET

INGREDIENTS

PART			PRICE
Case	NZXT Elite 210	NEW	$43
PSU	Corsair CX500M	NEW	$50
Mobo	ECS H77H2-M3 Micro ATX		$59
CPU	Intel Core i5-3350P		$180
Cooler	Stock Intel cooler		$0
GPU	Asus Radeon HD 7790 DirectCU II 1GB	NEW	$138
RAM	4GB (1x 4GB) Patriot Viper 3 DDR3/1600	NEW	$24
Optical Drive	Samsung SH-224BB	NEW	$15
SSD	SanDisk SDSSDP-064G-G25 64GB	NEW	$64
HDD	Western Digital Caviar Blue 1TB	NEW	$65
OS	Windows 8 64-bit OEM	NEW	$90

Approximate Price: $728

THIS BUILD IS AN evolution of the machine that won the three-way budget battle in our June issue. We've upgraded the Rosewill case/PSU combo to an NZXT Source 210 Elite and a Corsair CX500. The case has better cable management, more airflow options, and sturdier construction, and the CX500 has better build quality and modular cabling. The $10 rebate on the RAM made it the cheapest 1,600MHz 4GB stick available. We also raised our budget by $20 to score a stand-alone 64GB SSD so that we could install Windows on it, as before we were just using a 32GB caching drive along with a 500GB mechanical drive, so we've also doubled the capacity of our hard drive. We've also finally switched to Windows 8, mostly because we like its fast boot times.



BASELINE

INGREDIENTS

PART			PRICE
Case	Corsair Carbide 200R		$50
PSU	Cooler Master Silent Pro M2 720W		$75
Mobo	Gigabyte GA-Z87-UD3H	NEW	$180
CPU	Intel Core i5-4570K	NEW	$242
Cooler	Cooler Master Hyper 212 Evo		$32
GPU	MSI Radeon 7870 GHz Edition		$210
RAM	8GB Corsair Vengeance DDR3/1600		$52
Optical Drive	Samsung SH-224BB		$15
SSD	Samsung 840 Pro 128GB		$125
HDD	Seagate Barracuda 1TB		$70
OS	Windows 8 64-bit OEM	NEW	$90

Approximate Price: $1,141

WE'RE FINALLY replacing Intel's LGA1155 CPU and motherboard with new Socket 1150 Haswell parts, as they offer about 10 percent more performance over Ivy Bridge. 1150 also boosts the SATA 6Gb/s ports from two to eight (or more, on the high-end boards). We chose the Gigabyte board because it performed well in this month's Build It (see page 68). We didn't have a Haswell Core i5-4570K CPU at press time, but it's basically a Core i7-4770K (which we *have* tested) with Hyper-Threading disabled.

The feature-packed Cooler Master 720-watt Silent Pro M2 costs about the same as last month's Seasonic 650-watt M12II, so we're going back to it. We could have bumped the video card to a Radeon 7870 XT, but we haven't gotten our hands on one yet.



PERFORMANCE

DESPITE ALL THE Haswell hubbub, Sandy Bridge-E is still the better choice at the high end since it can take hexa-core CPUs and provides more than twice as many PCI Express lanes, ensuring that a multi-GPU setup won't run out of bandwidth. The Asus Sabertooth motherboard remains an expensive proposition, but we believe it's worth it for big overclocks.

With our motherboard and CPU still in place, the only really major change this month is in the GPU department, where we jettisoned the still-awesome Sapphire Vapor-X Radeon HD 7970 for the much faster GTX 780 from EVGA. We also opted to splurge a bit and pay the extra $10 for its fancy new ACX cooler, which is about 6 degrees cooler under full load than the Titan cooler, and a bit quieter, too. Lastly, we upgraded the system's PSU from the 720W Cooler Master Silent Pro M2 to the PC Power & Cooling Silencer Mk III 850W. It has a bit more juice and an 80 Plus "Gold" rating, so it should be extra reliable.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART		PRICE
Case	NZXT Phantom 630	$140
PSU	PC Power & Cooling Silencer Mk III 850W **NEW**	$130
Mobo	Asus Sabertooth X79	$325
CPU	Intel Core i7-3820	$290
Cooler	NZXT Kraken X40	$95
GPU	EVGA GeForce GTX 780 ACX **NEW**	$660
RAM	16GB Corsair Vengeance DDR3/1600	$100
Optical Drive	Asus BW-12B1ST	$60
SSD	Corsair Neutron GTX 256GB	$210
HDD	Seagate Barracuda 3TB	$135
OS	Windows 8 64-bit OEM **NEW**	$90

Approximate Price: $2,235

KICK ASS GEAR

Hardware we've deemed worthy of the highest honor



VIDEO CARD
Asus GeForce GTX 670 DirectCU II TOP
$425 (street), www.asus.com



GAMING HEADSET
Corsair Vengeance 1500
$100, www.corsair.com



AIR CPU COOLER
Cooler Master Hyper 212 Evo
$30 (street), www.coolermaster-usa.com



LIQUID CPU COOLER
Corsair H100
$115 (street), www.corsair.com



FULL-TOWER CASE
NZXT Switch 810
$150 (street), www.nzxt.com

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